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# TOPICS

TRAFFIC

OPERATIONS

PROGRAM TO

INCREASE

CAPACITY and

SAFETY

MISSOULA, MONTANA -- TOPICS

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May 31, 1973

Mr. Paul DeVine, P. E.  
Planning Research Director  
State of Montana, Department of Highways  
Helena, Montana 59601

Dear Mr. DeVine:

We are pleased to submit our TOPICS Report for the City of Missoula, Montana, which was conducted in accordance with our contract agreement dated March 28, 1972, with the State of Montana, Department of Highways.

A program of projects to increase both capacity and safety on the Type II System in Missoula is presented. The cost of the entire program is in excess of \$1,839,000.00. The program of recommended projects when implemented will significantly increase safety of high accident hazard locations and also provide a flexible network of streets capable of handling the traffic needs of that city.

We would like to take this opportunity to extend our appreciation for cooperation and valuable assistance rendered during the study by yourself and other Representatives and Personnel of the Planning Research Section, the Federal Highway Administration, the State Highway Division office in Missoula, the City Engineer, City Officials, and the Police and Fire Departments of Missoula.

We appreciate the opportunity allowing us to conduct this TOPICS Study.

Very truly yours,

VTN INC.

A handwritten signature in dark ink, appearing to read "David A. Twiddy".

David A. Twiddy, P. E.  
Vice President

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# CITY OF MISSOULA

## PLAN FOR AREAWIDE TRAFFIC OPERATION IMPROVEMENTS

MONTANA DEPARTMENT OF HIGHWAYS  
PLANNING RESEARCH BUREAU

AND

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION

FEBRUARY , 1973

Prepared By:

VTN INC. HELENA, MONTANA

The opinions, findings, and conclusions expressed in this publication  
are those of the authors and not necessarily those of the Federal  
Highway Administration.





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CHAPTER I

BACKGROUND AND SUMMARY OF FINDINGS

INTRODUCTION - THE FEDERAL-AID TOPICS PROGRAM

The purpose of the TOPICS Program is defined by its name: Traffic Operations Program to Increase Capacity and Safety. Its focus is on improving the efficiency, quality, and safety of traffic flow over the network of arterial streets. The TOPICS Program emphasis is upon traffic service improvement through utilization of traffic operations techniques and low-cost improvements capable of quick effectuation such as signing and marking, signalization, channelization and minor intersection widening, rather than upon major construction or reconstruction.

Within the context of the TOPICS Program, the purpose of this report is to identify Traffic Improvement Projects within the Missoula Urban Area and to establish an Implementation Program for the recommended improvements.

The TOPICS Program as outlined in Policy and Procedure Memorandum 21-18 is a Federal Urban Traffic Operations Program to increase the capacity and safety over a network of arterial and other major streets in an urban area. An agency shall have a continuing program within the designated Federal Urban Area Boundaries which shall consist of making traffic operation improvements on a systematic basis in accordance with an Areawide Plan. Since TOPICS does not contemplate major construction or reconstruction, but is intended to maximize the efficiency and to improve the level of service of the present street system, TOPICS Projects are normally composed of iniscellaneous items of work which generally are confined to the existing right-of-way and that are considered minor items on regular urban highway construction projects.

This study is intended to provide a base for selecting TOPICS Improvements. It focuses on short range improvements that possibly can be constructed within the next five years during which transportation plans and goals are being formulated, developed, financed and constructed. The TOPICS Program should complement these long range planning processes.

Several potential Traffic Improvement Projects have been identified, and it is intended that the analysis of these problems will permit the development of solutions with TOPICS support and, in some cases, with local or other funding. The listing of potential improvements does not represent a course of action; instead, it proposes solutions which merit consideration.

OBJECTIVES

The specific objectives of this study are:

Review the existing road and street system in the Missoula Federal Aid Urban Area and determine whether the approved tentative TOPICS System is adequate.

From this review recommend for approval additions, deletions, or modifications of the existing TOPICS System.

Review the present Federal Aid Systems and the designated TOPICS System to identify and select locations that appear to be significant points of congestion or accident hazard.

Review locations recommended by the City of Missoula, Montana Department of Highways and areas selected by the Consultant and prepare planning reports that will identify the problem, recommend solutions, estimate improvement costs, and justify the recommended improvements.

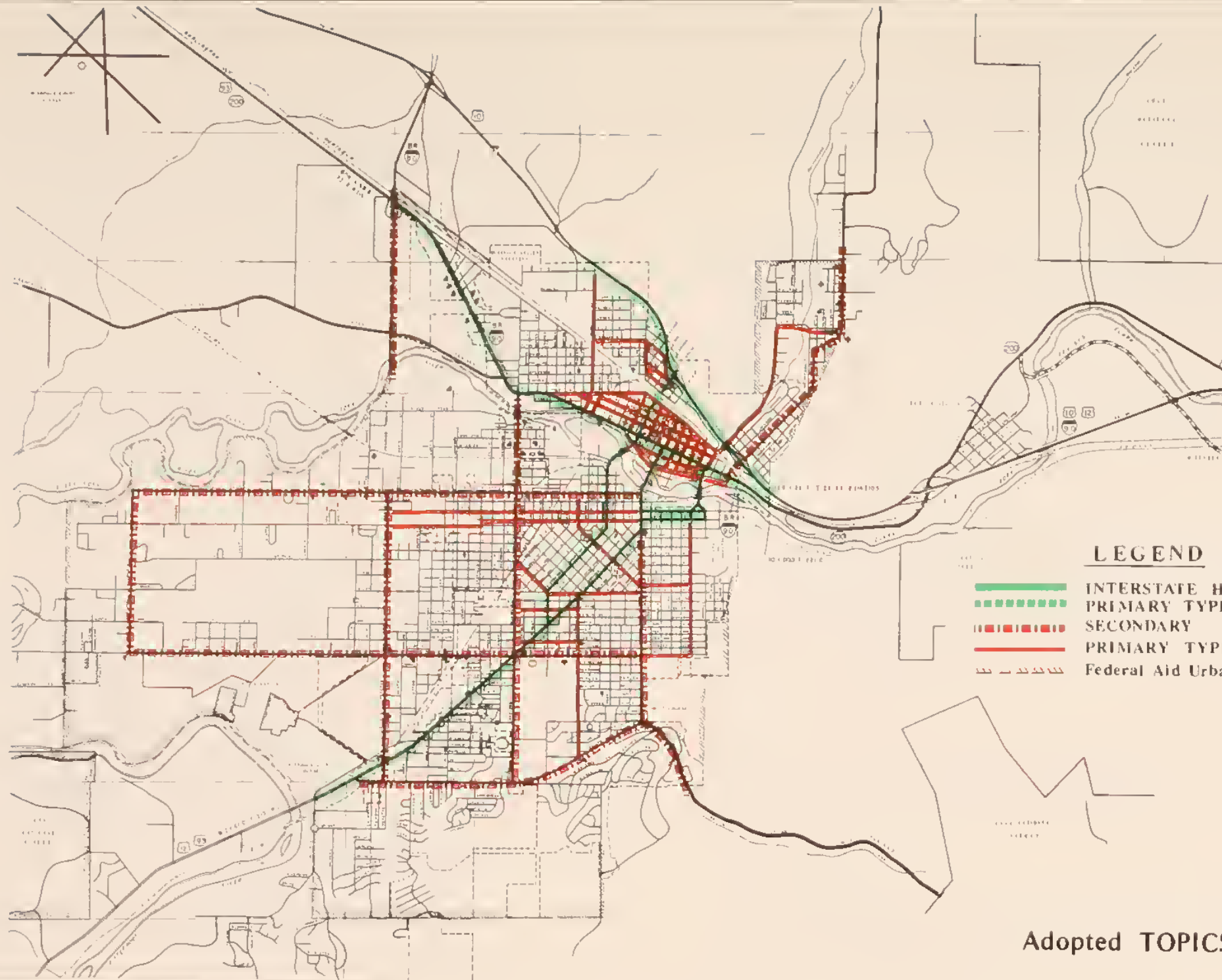
Establish a list of priorities for implementation of recommended improvements.

SUMMARY OF STUDY FINDINGS

It is our recommendation that the Recommended TOPICS System be approved by the City and County as the Final TOPICS System; provided the City accepts Alternate A as shown on the Orange Street-North 2nd to North 3rd Street Project Report (See Chapter IV and Chapter VI). Otherwise, North 2nd and a portion of Worden Street would be deleted from the system and would be shown as such. See Exhibit I.

No additions or deletions are recommended for the FAP I or FAS Systems. The recommended TOPICS System is shown on Exhibit 14 in Chapter IV and the mileage is tabulated by street route in Exhibit 13 in Chapter IV, and is summarized as follows:

|                                      |                    |
|--------------------------------------|--------------------|
| Federal-Aid Interstate (FAI)         | 2.20 miles         |
| Federal-Aid Primary Type I (FAP I)   | 11.68 miles        |
| Federal-Aid Secondary (FAS)          | 22.94 miles        |
| Federal-Aid Primary Type II (FAP II) | <u>22.32 miles</u> |
| System Total                         | 59.14 miles        |



Adopted TOPICS System

EXHIBIT NO. 1



The Central Business District was not studied in detail, however, considerable inventory data was collected and partial analysis made, see CBD in Chapter III. Upon completion of the CBD Development Study being completed by others, recommendations and additional data should be utilized to revise that portion of the TOPICS Study and Report.

Brooks Street Access Study was given considerable attention and planning projects prepared that recommend solutions compatible with City's objectives and consistent with TOPICS Program guidelines and constraints. The planning reports as presented herein propose construction either as separate projects, or if funding becomes available, these projects could be constructed as a large single segment project. The Brooks, South and Russell intersection, if constructed as one project would, of course, require reconstruction of three other intersections, e.g., South and Washburn, Brooks and Dearborn, and Dearborn and Russell in order to facilitate left-turn movements. Discussion of all of these potential solutions can be found in Chapter VI. In addition to the above Brooks Street TOPICS Project, the State Department of Highways has been working on the design of an Urban project covering complete reconstruction of Brooks Street, a portion of which includes the same project limits as presented herein. A location and design public hearing for the reconstruction project was held on August 20, 1969, and the Department of Highways is currently anticipating that the project could be awarded to contract in 1981. The reconstruction project calls for a wider roadway and does require right-of-way; whereas the TOPICS Project construction requires minimal right-of-way.

The city and State, within the near future, should jointly establish an overall Brooks-Stephens-Russell Commercial Area Circulation Plan perhaps incorporating the ultimate street roadway width and right-of-way requirements of the State's plan and the circulation, access, side street treatments, and traffic control device elements of the TOPICS Plan presented herein. In addition, the city in cooperation with the commercial establishments should examine internal circulation and major driveway access entrances in relation to possible side street vacations, an element not examined herein. Following the adoption of a master circulation plan by both agencies, for example the one contained herein, all city activities (issuing building permits, building setbacks, street vacations, land use changes, zoning changes, etc.) should be coordinated with the Plan so that the total goals would ultimately be realized.

The list of potential Planning Projects as presented in Chapter VI are not a total solution of the traffic problems being experienced by the City of Missoula. Some major widening projects are definitely needed as discussed in Chapter III. Since the majority of the projects suggested in both Chapter III and VI are on the State Highways System, the State should take special note of these projects and include them in their priority system.

A School Crossing Signing and Signal Study was conducted to recommend a Policy Guide for uniformity in signing and conformity with national standards as described in the *Manual on Uniform Traffic Control Devices for Streets and Highways*. The improvement project for School Crossing Protection Devices is included in Chapter VI and Appendix A. The improvement project as outlined is to be used from a planning standpoint and the City will be required to conduct detailed speed and gap studies and pedestrian counts at all locations shown.

Similar studies were made in addition to those mentioned above and include Fire Pre-emption Systems and other general areas affecting Traffic Operations and Safety. These studies can be found in Chapter III.

The study findings reveal that the total cost of all projects is recapped as follows:

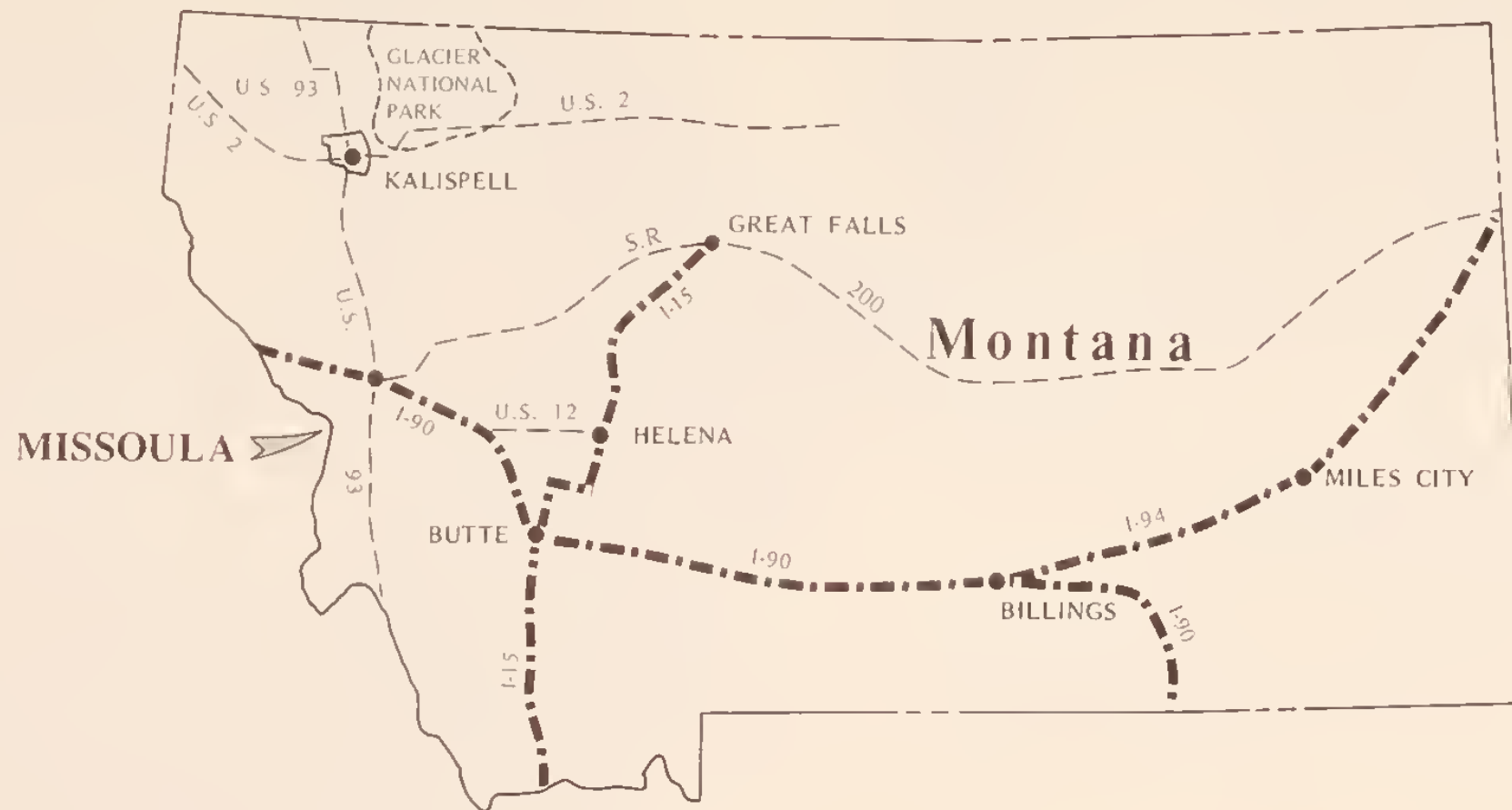
|                    |             |
|--------------------|-------------|
| Stage I Projects   | \$ 475,000  |
| Stage II Projects  | 1,263,000   |
| Stage III Projects | 101,000     |
|                    | <hr/>       |
| Grand Total        | \$1,839,000 |

Also included in the studies are reports on projects of a minor nature or not necessarily justified for TOPICS consideration at this time and the City should find other funding in order to implement these projects. These projects are discussed in Chapter VII.

LOCATION AND CHARACTER

The City of Missoula is located on the Clark Fork River near the midpoint of the western border of Montana and approximately 80 miles west of the Continental Divide. See Exhibit 2. Missoula is western Montana's largest city and principal trade center; logging, forest products, and manufacturing are the major industries. The University of Montana, student population 8,500, is the city's largest employer and thus constitutes an important economic and travel activity element of the city. Tourist services generated by the city's proximity to Glacier and Yellowstone National Parks and numerous other recreational attractions of the region also have significance for the city's economy and traffic demands. The study area, which incorporates the City of Missoula and adjacent urbanized areas, covers approximately 18 square miles of which 8 square miles are within the city limits.

\* U.S. Department of Transportation, Federal Highway Administration, *Manual on Uniform Traffic Control Devices for Streets and Highways*, U.S. Government Printing Office, Washington, D.C., 1971.



Vicinity Map

EXHIBIT NO. 2



GROWTH TRENDS

The study area population was estimated in 1965 to be 46,430, while the 1970 census reported a population of 29,497 for the City of Missoula. The population of the urbanizing areas outside the city limits has been growing more rapidly than the city itself. The population forecast for the study area for 1985 is 73,500, or a 36 percent increase over the 1965 estimate of 54,000. Population trends and projections are summarized in Exhibit 3.

EXHIBIT NO. 3  
Population Trends and Projections

| <u>Date</u> | <u>City of<br/>Missoula</u>                                                                          | <u>Study Area</u> | <u>Missoula<br/>County</u> | <u>Montana<br/>State</u> |
|-------------|------------------------------------------------------------------------------------------------------|-------------------|----------------------------|--------------------------|
| 1950        | 22,458                                                                                               | 31,147            | 35,493                     | 591,024                  |
| 1960        | 27,090<br>(2.06)                                                                                     | 39,759<br>(2.76)  | 44,663<br>(2.58)           | 674,767<br>(1.42)        |
| 1970        | 29,497<br>(0.89)                                                                                     | N.A.              | 58,263<br>(3.05)           | 694,409<br>(0.29)        |
| 1985        | N.A.                                                                                                 | 73,500            | N.A.                       | N.A.                     |
| (X.X)       | = % average annual growth rate from preceding date                                                   |                   |                            |                          |
| N.A.        | = Not available                                                                                      |                   |                            |                          |
| Sources:    | U.S. Census; <i>Urban Transportation Plan</i> , Missoula, Montana 1967; Missoula Chamber of Commerce |                   |                            |                          |

EXISTING TRANSPORTATION SYSTEMS

Three major State Highways serve and traverse the City of Missoula: Interstate 90, U.S. 12, and U.S. 93. Interstate 90 (also designated U.S. 10) provides access to Butte, Montana on the east and Spokane, Washington to the west. Interstate 90 crosses the northern edge of the city on a northwesterly course. Full interchanges are located at Van Buren Street, Orange Street, and Reserve Street. See Exhibits 2 and 4.

U.S. 93 is the principal north-south route, connecting Missoula with Kalispell and Glacier National Park to the north and central and Southern Idaho to the south. U.S. 93 runs northeasterly across the City as Brooks Street and Stephens Avenue, turning west in the Central Business District (CBD) via Broadway, which is the primary east-west street north of the river and connects to the interchange access streets noted above.

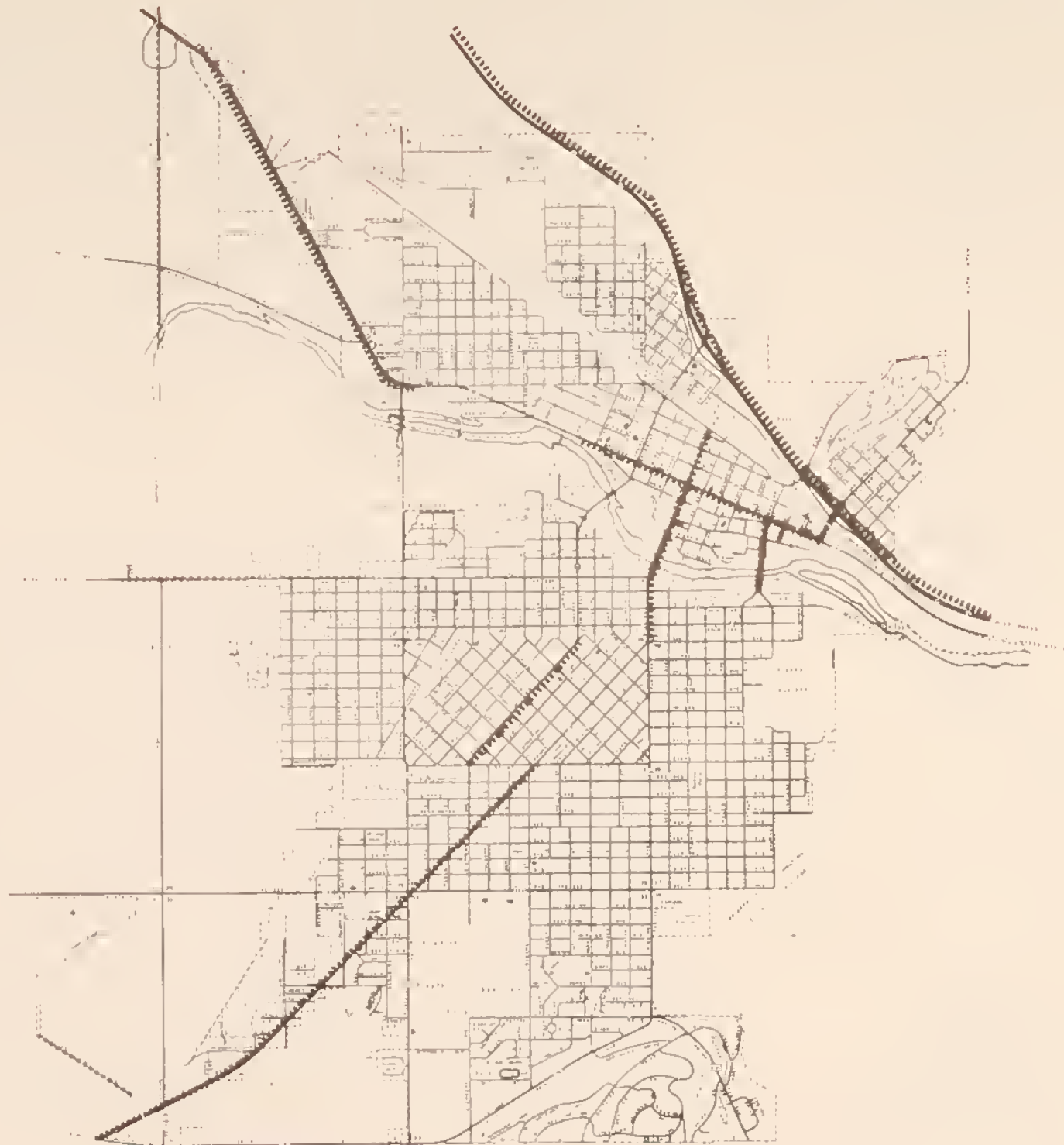
U.S. 12 provides access to Helena on the east and Central Idaho to the west. U.S. 12 is carried along with U.S. 93 on Brooks Street except that it proceeds along Brooks Street to Higgins Avenue whence it turns north to the 5th Street - 6th Street one-way couplet and proceeds east along the 5th Street - 6th Street couplet, north along Madison Street across the Clark Fork River, and east along Broadway to the Van Buren Interchange. U.S. 12 Business follows Higgins Avenue to the CBD, whence it turns east on Broadway to join with U.S. 12 at Madison Street.

Other important major streets are: Russell Street, running north-south through the western half of the city, and South Avenue, which provides east-west service across the southern portion of the city.

The Clark Fork River crosses the city east to west, separating the CBD and northern portion of the City from the southern two-thirds of the city, which contains the majority of the city population. The Chicago, Milwaukee, St. Paul and Pacific Railroad follows the southern bank of the Clark Fork River, which together form the primary travel barrier in Missoula. The Burlington Northern Railroad constitutes a secondary barrier, separating the northern-most portion of the city from the CBD. There are four bridge crossings over the Clark Fork River: Russell Street (two lanes), Orange Street (two lanes), Higgins Avenue (four lanes), and Madison Street (four lanes). These are the only arterial routes which cross the Milwaukee Road (two lane underpass at Russell Street, a two-lane overpass at Orange Street, and the Higgins Avenue and Madison Street bridges). The Orange Street underpass (two lanes), the Van Buren Street underpass (four lanes) and the Duncan Drive at-grade crossing of the Burlington Northern Rail Line provide the only access to the northern-most area of the city. Thus Orange Street, which terminates at the I-90 interchange, is the only cross-town street crossing over the river and both rail line barriers.

The Burlington Northern Railroad provides AMTRAK passenger service and freight service, while the Milwaukee Road provides freight service only. Burlington Northern has a switch yard east of Orange Street, and the Milwaukee Road has yard facilities to the east of Russell Street.

Intercity bus service is provided by Northwest Greyhound, Intermountain Bus Lines, Clearwater Stage, Inc., Sun River Stage Lines, and Clark Fork Valley Express Company



CITY PLAT  
**MISSOULA**  
MISSOULA COUNTY  
**MONTANA**

1970 CENSUS 29,497

SCALE IN FEET

2400 0 2400 4800

REVISED DEC 31, 1971



LEGEND

----- MULTILANE FACILITY

General Street Map

EXHIBIT NO. 4

The Missoula County Airport is located approximately eight miles northwest of downtown Missoula off U.S. 93. Scheduled service is provided by Northwest Orient Airlines and Frontier Airlines. No projects are contemplated in the Areawide TOPICS Plan which would significantly improve access to the airport.

There is no local transit service in Missoula and no anticipated future service at the present time, thus obviating the need to coordinate TOPICS planning with mass transit requirements. A Transit Study was prepared for the City in 1969.

## STUDY METHODOLOGY AND IMPLEMENTATION CONSIDERATIONS

The initial task was the review of the existing Federal-aid System streets, including the tentative Type II System as agreed upon by the City of Missoula and the Department of Highways. From this review coupled with meetings of City, County, State and FHWA personnel, a revised tentative TOPICS System was developed for the study area.

Following this stage a basic compilation (see Chapter II) of all available traffic data was undertaken and discussions held with local agencies to obtain an indication of trouble spots. Based upon actual field observations, automatic traffic count data, manual turning movement count data, accident data, observed congested traffic flows, and agency staff inputs, a potential TOPICS project list was compiled. The potential TOPICS project list was then re-examined to determine those projects that would warrant implementation under the TOPICS Program. This preliminary list of potential improvements was reviewed, revised and approved by the City, State, and FHWA personnel.

Finally, these problem locations were studied to determine improvement possibilities, costs, benefits, and affect upon the street network. The projects were then arrayed based upon a cost-effectiveness ratio incorporating deficiencies such as restricted capacity, number of accidents, accident rates, number of conflict points, travel time, route continuity, pedestrian activity, and geometric configuration as related to the average daily traffic and the cost of the improvement. (See Chapter IV)

Projects which appear to be the most critical and can be fully justified are presented in Project Planning Form in Chapter VI. Justified projects which have been fully documented and submitted for early funding and implementation are briefly described in Chapter V. Projects which should be considered for implementation, but are not necessarily justified at this time or may be outside the scope of the TOPICS Program, are described in a modified format contained in Chapter VII.

## EVALUATION

During the continuing phase of the TOPICS Program, certain significant, completed TOPICS Projects will be selected for evaluation of the effectiveness of the improvements. It is suggested that standard "before and after" studies, which compare changes in travel delay, accident frequency, etc., be utilized. These evaluations will aid in planning future improvement projects.

## TECHNICAL CAPABILITIES

The City of Missoula has recently developed a continuing traffic operations program. The city has a Traffic Engineer who reports to the City Engineer. A technical assistant devotes a portion of his time to traffic signal device maintenance. At the present time, private electrical firms are utilized for maintenance of the traffic signal equipment. Therefore, it appears that the city is adequately staffed to insure proper maintenance of the existing and proposed traffic control devices.

## LAWS AND ORDINANCES

The Code of the City of Missoula, Chapter 20, "Motor Vehicles and Traffic", specifies vehicle standards, rules of the road, and standards for traffic signing, markings, and signalization. It applies to all types of traffic situations and also specifies the duties and authority of the Police Department and City Engineer, and states that the traffic engineering functions be the responsibility of the Police Chief.

City ordinances are in effect covering required minimum setback for buildings along arterial streets, curb cut regulations, and off-street parking in commercial areas.

Generally the existing codes and ordinances are quite comprehensive and the basic enforcement, at this time, appears to be good. It is recommended that necessary revisions be made to bring them into conformance with the current Motor Vehicle Code of the State of Montana, and to place the traffic engineering functions within the engineering department.

## COMPREHENSIVE TRANSPORTATION AND DEVELOPMENT PLANS

In October, 1967, the Missoula City-County Planning Board completed comprehensive urban transportation and development plans for the Missoula Urban Area which were subsequently adopted by the appropriate City and County agencies. The study results are contained in a report entitled *Urban Transportation Plan*. The plan establishes general

guidelines through 1985 for the desirable development of the Missnola region. Additional information on the plans as related to the TOPICS Program is included in subsequent chapters.

There is no continuing comprehensive transportation planning process; however, an update of the Transportation Study is being contemplated by the State Highway Department.

A Capital Improvements Program, dated December 1968, outlines improvements through 1988, providing funds become available. Since the document is an optimistic approach for the scheduling of projects and is not based upon available funds, the TOPICS Program contained herein is not necessarily coordinated with the Capital Improvements Program.



CHAPTER II  
INVENTORIES

LAND USE AND MAJOR TRAFFIC GENERATORS

The *Urban Transportation Plan* shows existing and proposed land use patterns for the Missoula area. Those elements of principal traffic generation are summarized herein. Three primary commercial areas are: the CBD and the Brooks Street (U.S. 93) and West Broadway commercial strips. Major industrial areas are located in the northwest area north of the Burlington Northern Railroad Tracks, in the central area south of the Milwaukee Tracks between Russell Street and Orange Street, and in the southwest area north of the Brooks Street commercial strip. The larger public parks and open spaces are for the most part concentrated near the southern, eastern, and western edges of the city. The 1985 land use plan indicates no major changes in the overall land use pattern. The northwestern industrial area will extend further to the northwest. The bulk of future residential development must conform to the barriers posed by adjacent upland terrain and national forest lands, and will primarily take place in western Missoula on both sides of the Clark Fork River, the southwest area along U.S. 93, and the northeast area along Brayton Avenue in the Rattlesnake watershed.

In addition to the industrial and commercial areas, major traffic generators include the University of Montana southwest of the CBD and two hospitals adjacent to the CBD.

ROADWAY CHARACTERISTICS AND TRAFFIC CONTROL

**Geometric Configuration.** A city-wide TOPICS system geometric inventory was not undertaken as a part of this study. Approximately 5 years ago the City Engineering Department inventoried the entire city including street widths, curb radii, utilities, road profiles, etc. under a HUD Program. The information is presented on detailed, scaled drawings which are on file at the City Engineer's office. Since very few improvements have been constructed in the last five years, it was determined that these drawings were still valid for use on this study. However, street widths, etc., were verified in the field as necessary.

**Multilane Facilities.** The following major street and highway segments located on the General Street Map (Exhibit 4) are operated with four moving traffic lanes (extremely short sections of multilane street are omitted):

| <u>Street/Highway</u> | <u>From</u>    | <u>To</u>        |
|-----------------------|----------------|------------------|
| Brooks Street         | 39th Street    | Mount Avenue     |
| Higgins Avenue        | Brooks Street  | Railroad Avenue  |
| Madison Street        | 6th Street     | Broadway         |
| Van Buren Street      | Broadway       | Interstate 90    |
| Broadway              | Reserve Street | Byron Street     |
| Broadway              | May Street     | Van Buren Street |

Stephens Street between Mount Avenue and Orange Street is capable of four-lane operation although it is marked for only two-lanes. Nearly all segments of the CBD street network could accommodate multilane operation if curb parking were removed on one or both sides of the streets. Only a few short segments of the balance of the arterial system could be operated as four-lane streets with restriction of curb parking. There are few separate turning lanes provided on the four-lane facilities listed above.

**One-Way Streets.** One-way traffic operations have been established on two pairs of major streets in Missoula: Front and Main Streets downtown, and South 5th and 6th Streets between Russell Street and Madison Street.

**Curb Parking.\*** There are few present curb parking prohibitions in Missoula other than selected spot prohibitions near some intersection corners. Since much of the arterial street system lacks curbing, parking on shoulder and border areas is not uncommon, particularly where sidewalks are absent. Diagonal parking is permitted on several segments of the TOPICS System; primarily in the Central Business District. In the past, indiscriminate curb cuts have been allowed in order to provide diagonal parking either entirely on the public right-of-way or on a combination of public right-of-way and private property. In the latter case, the net result is blockage of the sidewalk and a hazard potential to the through traffic from the backing automobiles. At the present time, the city is changing its policy for curb cuts and is enforcing its ordinances.

**Traffic Signals.** Exhibit 6 shows the location of existing vehicular traffic signals. An indication of the operating deficiency of existing signals is partially indicated by designation of signals which are to be reconstructed or otherwise improved in connection with specific TOPICS project locations as described later in this report. Exhibit 5 lists existing signals

<sup>+</sup>As indicated in the *Missoula Urban Transportation Plan* the existing curb plus off-street parking supply is deficient for current demands for a few blocks within the CBD.



# EXHIBIT NO. 5

## Traffic Signal Operations Data List

| <u>Intersection</u>           | <u>Type*</u> | <u>Existing Phases</u> | <u>Type</u> | <u>Proposed Initial</u> | <u>Future</u> |
|-------------------------------|--------------|------------------------|-------------|-------------------------|---------------|
| 1. Broadway and Russell       | Full         | 3                      | Full        | 4                       | 4             |
| 2. Spruce and Orange          | Semi         | 2                      | --          | --                      | 2             |
| 3. Pine and Orange            | --           | --                     | Semi        | 2                       | 2             |
| 4. Broadway and Orange        | Fixed        | 2                      | Fixed       | 2                       | 2             |
| 5. Orange, Main and Front     | Fixed        | 2                      | Fixed       | 2                       | 2             |
| 6-12. CBD**                   | Fixed        | 2                      | Fixed       | 2                       | 2             |
| 13. Adams and Broadway        | Semi         | 2                      | --          | --                      | --            |
| 14. Madison and Broadway      | Full         | 3                      | Full        | 3                       | 5             |
| 15. Van Buren and Broadway    | Full         | 3                      | Full        | 3                       | 3             |
| 16. 3rd and Russell           | Full         | 2                      | Full        | 3                       | 5             |
| 17. 5th and Russell           | --           | --                     | Semi        | 2                       | 2             |
| 18. Strand and Russell***     | --           | --                     | Semi        | 2                       | 3             |
| 19. Kent and Russell***       | --           | --                     | Semi        | 2                       | 3             |
| 20. Brooks, South and Russell | Full         | 4                      | Full        | 3                       | 3             |
| 21. 3rd and Reserve           | --           | --                     | Full        | 2                       | 3             |
| 22. South and Reserve         | --           | --                     | Full        | 2                       | 3             |
| 23. Brooks and Reserve        | --           | --                     | Full        | 2                       | 5             |
| 24. 39th and Russell          | --           | --                     | Full        | 2                       | 3             |
| 25. 3rd and Orange            | Fixed        | 2                      | Semi        | 2                       | 3             |
| 26. 5th and Orange            | Fixed        | 2                      | Semi        | 2                       | 2             |
| 27. 6th and Orange            | Fixed        | 2                      | Semi        | 2                       | 2             |
| 28. Beckwith and Stephens     | Semi         | 2                      | Semi        | 2                       | --            |
| 29. Mount and Stephens        | --           | --                     | Semi        | 2                       | 3             |

| <u>Intersection</u>       | <u>Type*</u> | <u>Existing Phases</u> | <u>Type</u>   | <u>Proposed Initial</u> | <u>Future</u> |
|---------------------------|--------------|------------------------|---------------|-------------------------|---------------|
| 30. Strand and Stephens   | --           | --                     | Semi          | 2                       | 2             |
| 31. 4th and Higgins       | Fixed        | 2                      | Semi          | 2                       | 2             |
| 32. 5th and Higgins       | Fixed        | 2                      | Fixed         | 2                       | 2             |
| 33. 6th and Higgins       | Fixed        | 2                      | Fixed         | 2                       | 2             |
| 34. Brooks and Higgins    | Fixed        | 2                      | Fixed         | 2                       | 2             |
| 35. Beckwith and Brooks   | Semi         | 2                      | Semi          | 2                       | --            |
| 36. Mount and Brooks      | --           | --                     | Semi          | 2                       | 2             |
| 37. Strand and Brooks     | --           | --                     | Semi          | 3                       | 3             |
| 38. Stephens and Brooks   | Semi         | 2                      | Full          | 3                       | 3             |
| 39. Regent and Brooks     | --           | --                     | Semi          | 2                       | 2             |
| 40. Dearborn and Brooks   | --           | --                     | Full          | 5                       | 5             |
| 41. Beckwith and Higgins  | --           | --                     | Semi          | 2                       | 2             |
| 42. South and Higgins     | --           | --                     | Full          | 2                       | 2             |
| 43. 6th and Arthur        | --           | --                     | Semi          | 2                       | 2             |
| 44. Beckwith and Arthur   | --           | --                     | Semi          | 2                       | 2             |
| 45. Arthur and University | Fixed        | 2                      | to be removed |                         |               |

\* Type of Signal Controller:  
Fixed-time  
Semi-traffic actuated  
Full-traffic actuated

\*\* Installations need reconstruction. See CBD Study Chapter III

\*\*\* Possible future construction - not necessarily TOPICS funded

CITY PLAT  
**MISSOULA**  
 MISSOULA COUNTY  
 MONTANA

1970 CENSUS 29,497

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**LEGEND**

- EXISTING
- ◻ PROPOSED FOR RECONSTRUCTION UNDER TOPICS
- ⊙ RECONSTRUCTION UNDER OTHER PROGRAMS
- PROPOSED FOR CONSTRUCTION UNDER TOPICS
- FUTURE CONSTRUCTION NOT NECESSARILY TOPICS

Traffic Signal Locations



EXHIBIT NO. 6

by location, type of control (fixed or traffic-actuated), and number of signal phases. Most of the signals are two-phase fixed-time installations and most lack pedestrian indications ("WALK, DONT WALK"). A number of the signal controllers in the CBD are over twenty years old and in poor operating condition. An incomplete interconnect network in the CBD prevents coordinated signal operation. Almost none of the outlying signals are interconnected. A fire pre-emption system covers a large majority of the signals. Signal visibility -- in terms of number and placement of heads, lens size, backplates and visors -- is inadequate at most of the locations.

Not included in Exhibit 5 and Exhibit 6 are mid-block pedestrian signals. There are thirteen such installations on the TOPICS System in the Missoula Urban Area. All are associated with school crossings, and all but one are located immediately adjacent to elementary schools. In general there is no conformance of operation and display throughout the urban area. In some cases a flashing red lens is displayed to motorists at one location and solid red at another location on the same route.

**Traffic Volumes.** The 1972 annual average daily traffic (AADT) carried by the TOPICS System is shown in Exhibit 7. The AADT's were derived from machine counts taken by VTN during the spring and summer of 1972 and supplemented by recent counts taken by the Department of Highways. Counts were corrected for seasonal variation in traffic flow to produce AADT's. Intersection turning movement counts were also taken by VTN at important intersections and supplemented with turning movement counts taken in recent years by the Department of Highways. The turning movement counts are shown on individual project planning Improvement Diagrams.

U.S. 12 and U.S. 93 are the heaviest traveled routes, and along with Russell Street have shown the greatest increase in recent traffic growth among Missoula's arterials. With the pronounced development trend to the southwestern portion of the urban area, Brooks Street, Russell Street, S. 39th Street, and South Avenue can be expected to experience substantial future traffic growth.

Near-peak-hour traffic flows occur throughout most of the daytime hours on most of the TOPICS System, (for example see page 48) resulting in peak-hour volumes of seven to nine percent of AADT rather than the ten percent or greater often found in urban areas of comparable size. Regional character, local work shift patterns and the presence of the University of Montana are major factors responsible for this characteristic.

**Traffic Accidents.** Intersection accident collision diagrams for the years 1970 and 1971 were obtained from both the City Traffic Department and the Department of Highways

and were used to develop a listing of high-accident locations and provide a basis for development of possible traffic engineering improvements and determination of improvement project priorities. Accident data for mid-block locations was not readily available.

Exhibit 8 lists by total accident rank all intersections on the TOPICS System having five or more reported accidents in one year and are shown for a two-year period. It is estimated that these locations accounted for over half of the city-wide intersection accident total. In Exhibit 9 these locations are re-ranked on the basis of accident rate -- the number of accidents x  $10^6$  divided by total yearly traffic accommodated by the intersection -- and are shown by location on Exhibit 10. The intersections of Brooks Street at Stephens Avenue (32 accidents), Broadway at Madison (31) Broadway at Orange Street (31), and Brooks Street at Russell Street and South Avenue (30) stand out in terms of total accidents, while in terms of accident rate Arthur Avenue at 6th Street is far and above the most hazardous location in the city. Street segments exhibiting a concentration of high accident rate locations are Brooks Street (from Russell Street to Stephens Avenue), Higgins Avenue (Brooks Street to 4th Street), and Orange Street (Front Street to Pine Street). Of the top ten high-accident locations (total accident basis) seven were also among the top ten for the period 1963-1965\* and showed an increase in annual accidents since that time.

Although not used during the analysis stage to select and design the potential TOPICS improvements contained herein, the high 17 accident locations for 1972 are included on Exhibit 8. Although the order has changed, for the most part, the 1972 accidents reinforce the projects selected for improvement under the TOPICS Program. The only location not appearing on the 35 high accident locations for 1970-71 is Brooks Street and Tremont. Very few of the intersections along the "93 Strip" are ranked in 1972. By city admission and perhaps by poor reporting by positive location of mid-block accidents, which is the case on the "93 Strip" with no intersection definition, no curbs, and many driveways, the intersection collision diagrams are not representative of this area. As a whole in 1972, the "93 Strip" again had one of the highest accident experiences of any street segment in the city.

\*"Urban Transportation Plan". Missoula, Montana, October 1971.



EXHIBIT NO. 7

# EXHIBIT NO. 8

## Accident Breakdown Rank by Number of Accidents

| Rank | Intersection            | No. of Accidents |      |       | 1972 |      | Rank | Intersection             | No. of Accidents |           |       | 1972 |      |
|------|-------------------------|------------------|------|-------|------|------|------|--------------------------|------------------|-----------|-------|------|------|
|      |                         | 1970             | 1971 | Total | No.  | Rank |      |                          | 1970             | 1971      | Total | No.  | Rank |
| 1    | Brooks & Stephens       | 16               | 16   | 32    | 14   | 8    | 19   | Orange & N. 3rd          | 6                | 8         | 14    | 11   | 14   |
| 2    | Broadway & Madison      | 13               | 18   | 31    | 11   | 14   | 20   | Higgins & Main           | 5                | 8         | 13    | 11   | 14   |
| 2    | Broadway & Orange       | 13               | 18   | 31    | 44   | 1    | 20   | Orange & N. 2nd          | 6                | 7         | 13    |      |      |
| 4    | Brooks, South & Russell | 18               | 12   | 30    | 24   | 2    | 22   | Cottonwood & S. 3rd      | 4                | 8         | 12    |      |      |
| 5    | Broadway & Higgins      | 13               | 12   | 25    | 21   | 3    | 22   | Front & Higgins          | 6                | 6         | 12    |      |      |
| 5    | Arthur & S. 6th         | 11               | 14   | 25    |      |      | 22   | Russell & S. 5th         | 10               | 2         | 12    |      |      |
| 7    | Front, Main & Orange    | 10               | 14   | 24    | 16   | 7    | 22   | Bancroft & Strand        | 6                | No Counts | 12    |      |      |
| 8    | Broadway & Russell      | 11               | 12   | 23    | 19   | 5    | 26   | Brooks & Beckwith        | 6                | 4         | 10    | 13   | 11   |
| 9    | Russell & S. 3rd        | 12               | 9    | 21    | 11   | 14   | 26   | Broadway & Toole         | 5                | 5         | 10    |      |      |
| 10   | Orange & Pine           | 13               | 6    | 19    |      |      | 28   | Orange & Alder           | 4                | 5         | 9     |      |      |
| 10   | Higgins & S. 6th        | 10               | 9    | 19    | 21   | 3    | 28   | Brooks, Bancroft & Mount | 4                | 5         | 9     | 10   | 17   |
| 12   | Brooks & Higgins        | 9                | 9    | 18    | 14   | 8    | 28   | Stephens & Strand        | 6                | 3         | 9     |      |      |
| 13   | Brooks & Roosevelt      | 5                | 12   | 17    | 14   | 8    | 31   | Russell & S. 11th        | 5                | 2         | 7     |      |      |
| 13   | Brooks, Oxford, Sussex  | 7                | 10   | 17    |      |      | 31   | Brooks & Kensington      | --               | --        | 7     |      |      |
| 15   | Higgins & S. 5th        | 5                | 11   | 16    | 18   | 6    | 31   | Brooks & Kent            | 5                | 2         | 7     |      |      |
| 15   | Broadway & Van Buren    | 5                | 11   | 16    | 12   | 13   | 31   | Brooks & Strand          | --               | --        | 7     |      |      |
| 15   | Higgins & S. 4th        | 6                | 10   | 16    |      |      | 35   | Higgins & Spruce         | 5                | 1         | 6     |      |      |
| 15   | Bancroft & South Avenue | 14               | 2    | 16    |      |      | 35   | Kent & Russell           | 5                | 1         | 6     |      |      |
|      |                         |                  |      |       |      |      | --   | Brooks & Tremont         | 2                | 4         | --    | 13   | 11   |



# EXHIBIT NO. 9

## Accident Breakdown

### Rank by Accident Rate

| Rank | Intersection            | Rank By<br>Total<br>Accidents | Total<br>Accidents<br>2 Yrs. (70-71) | ADT    | Rate | Rank | Intersection                | Rank By<br>Total<br>Accidents | Total<br>Accidents<br>2 Yrs. (70-71) | ADT    | Rate |
|------|-------------------------|-------------------------------|--------------------------------------|--------|------|------|-----------------------------|-------------------------------|--------------------------------------|--------|------|
| 1    | Arthur & S. 6th St.     | 6                             | 25                                   | 13,450 | 2.54 | 19   | Russell & S. 5th St.        | 24                            | 12                                   | 13,560 | 1.21 |
| 2    | Bancroft & Strand       | 25                            | 6 (70)                               | 7,000  | 2.35 | 20   | Broadway & Higgins          | 5                             | 25                                   | 28,710 | 1.19 |
| 3    | Orange & N. 3rd St.     | 19                            | 14                                   | 8,866  | 2.16 | 21   | Higgins & S. 4th St.        | 16                            | 16                                   | 21,428 | 1.02 |
| 4    | Orange & Pine           | 10                            | 19                                   | 12,500 | 2.08 | 22   | Higgins & S. 6th St.        | 11                            | 19                                   | 25,919 | 1.00 |
| 5    | Bancroft & South        | 17                            | 16                                   | 10,856 | 2.02 | 23   | Broadway & Russell          | 8                             | 23                                   | 33,278 | 0.95 |
| 6    | Orange & N. 2nd St.     | 21                            | 13                                   | 8,866  | 2.01 | 24   | Orange & Alder              | 28                            | 9                                    | 13,066 | 0.94 |
| 7    | Cottonwood & S. 3rd St. | 22                            | 8 (71)                               | 5,500  | 2.00 | 25   | Brooks & Higgins            | 12                            | 18                                   | 26,794 | 0.92 |
| 8    | Brooks & Stephens       | 1                             | 32                                   | 22,046 | 1.99 | 26   | Higgins & S. 5th St.        | 14                            | 16                                   | 24,350 | 0.90 |
| 9    | Broadway & Madison      | 2                             | 31                                   | 24,000 | 1.77 | 27   | Brooks & Beckwith           | 26                            | 10                                   | 15,500 | 0.88 |
| 10   | Broadway & Orange       | 3                             | 31                                   | 25,100 | 1.69 | 28   | Russell & S. 11th St.       | 31                            | 7                                    | 14,000 | 0.68 |
| 11   | Brooks, South & Russell | 4                             | 30                                   | 24,822 | 1.65 | 29   | Front & Higgins             | 23                            | 12                                   | 24,000 | 0.68 |
| 12   | Brooks & Roosevelt      | 13                            | 17                                   | 15,000 | 1.55 | 30   | Broadway & Toole            | 27                            | 10                                   | 22,000 | 0.62 |
| 13   | Front, Main, Orange     | 7                             | 24                                   | 22,104 | 1.49 | 31   | Higgins & Main              | 20                            | 13                                   | 28,710 | 0.61 |
| 14   | Broadway & Van Buren    | 15                            | 16                                   | 15,000 | 1.46 | 32   | Higgins & Spruce            | 33                            | 6                                    | 13,600 | 0.60 |
| 15   | Russell & S. 3rd St.    | 9                             | 21                                   | 20,836 | 1.38 | 33   | Brooks, Bancroft<br>& Mount | 29                            | 9                                    | 20,800 | 0.59 |
| 16   | Brooks & Oxford         | 18                            | 17                                   | 17,000 | 1.36 | 34   | Brooks & Kent               | 32                            | 7                                    | 22,000 | 0.44 |
| 17   | Russell & Kent          | 34                            | 6                                    | 13,000 | 1.26 |      |                             |                               |                                      |        |      |
| 18   | Stephens & Strand       | 30                            | 9                                    | 10,000 | 1.23 |      |                             |                               |                                      |        |      |

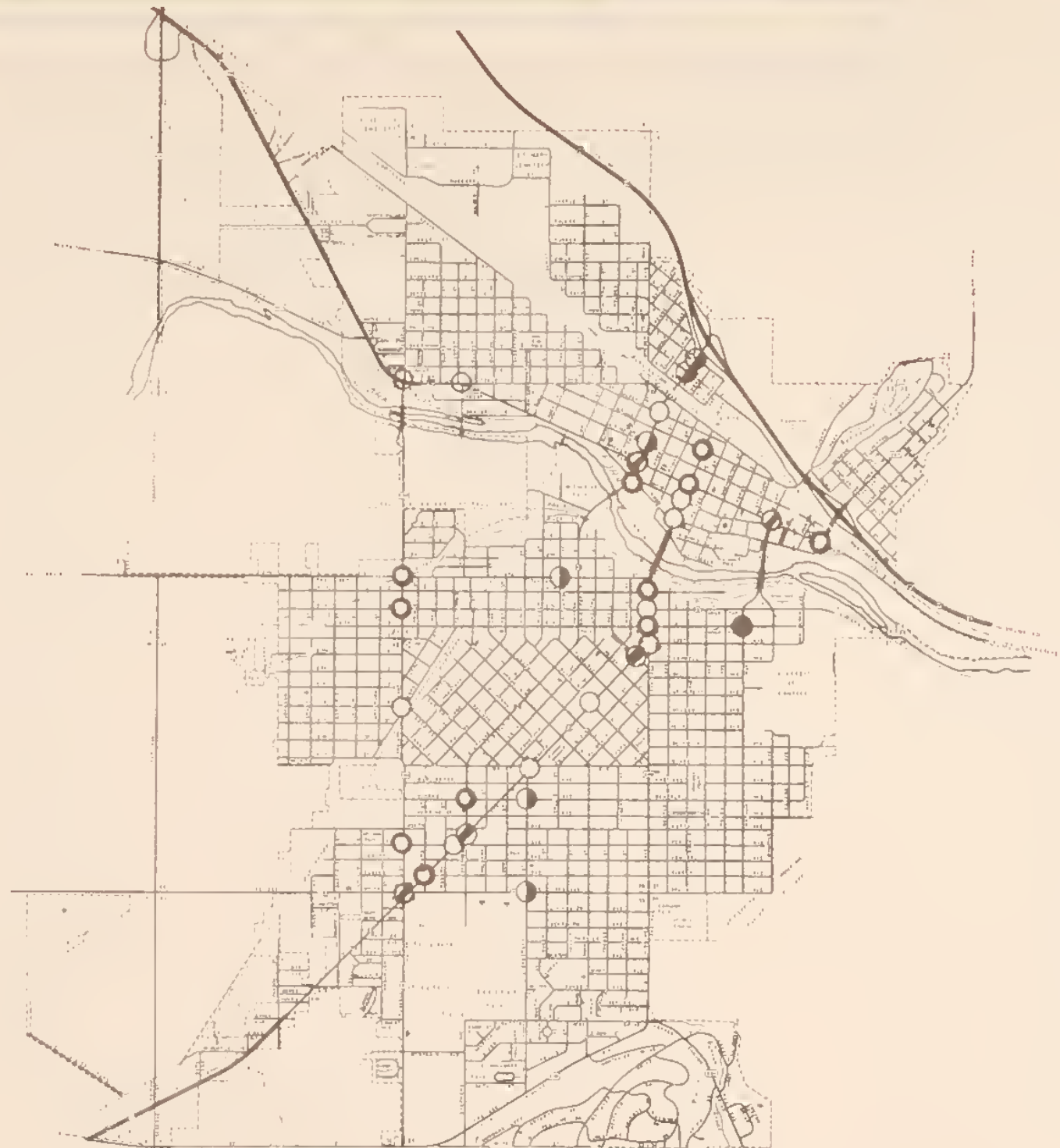
\* Accident Rate =  $\frac{(\text{ACC./Year}) (1,000,000)}{(\text{AADT}) (365)}$

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ACCIDENT RATES \*

|                |   |
|----------------|---|
| 0.5 - 1.0      | ○ |
| 1.0 - 1.5      | ● |
| 1.5 - 2.0      | ◐ |
| 2.0 - 3.0      | ◑ |
| 2.5 - and over | ● |

\* Per Million Vehicles/Year

Accident Rates by Intersection

EXHIBIT NO. 10

PROGRAMMED CONSTRUCTION PROJECTS

In order to prevent duplication of potential work items under the TOPICS Program with any other planned construction projects, information was developed for city and Department of Highways projects which are currently programmed or under construction. The spot improvement projects are listed below and are also located in Chapter V. (Most are to be funded in part by the TOPICS Program).

| <u>Location</u>                                          | <u>Major Improvement Elements</u>                              | <u>Agency</u>     |
|----------------------------------------------------------|----------------------------------------------------------------|-------------------|
| Broadway                                                 | Widening at Burlington-Northern Railroad Track; channelization | Dept. of Highways |
| 6th St. @ Arthur Ave.                                    | Signalization                                                  | Dept. of Highways |
| Arthur Ave. @ Beckwith Ave.                              | Signalization                                                  | Dept. of Highways |
| Orange @ Main and Front Sts.                             | Reconstruct Signals                                            | Dept. of Highways |
| Higgins Ave. @ 4th, 5th, & 6th Sts. & Eddy Ave. (4-9999) | Reconstruct Signals                                            | Dept. of Highways |
| Orange St.: 3rd St. to 6th St.                           | Widening; reconstruction of signals @ 3rd, 5th, 6th Sts.       | Dept. of Highways |
| Higgins Ave. @ South Ave.                                | Signalization                                                  | Dept. of Highways |
| Russell St.: 5th St. to 6th St.                          | Widening; signalization at 5th St.                             | Dept. of Highways |
| Broadway and Orange St.                                  | Reconstruct Signals                                            | Dept. of Highways |

Other major projects, either on the TOPICS System or that will affect the TOPICS System projects, programmed for construction in the near future are:

| <u>Location</u>                                | <u>Major Improvement Elements</u>                                                                   | <u>Agency and Improvement Date</u>      |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Reserve St.                                    | Extension of Reserve St. from South 3rd St. to Mullen Rd., with new bridge across Clark Fork River. | Dept. of Highways, 1975-1976            |
| Fort Missoula Rd. @ Reserve St. & South Avenue | Re-alignment of Fort Missoula Rd.                                                                   | City of Missoula & Missoula County 1973 |
| Wapikiya Subdivision area                      | New collector road, from 23rd Ave. to 39th St. near Russell Ave.                                    | Others                                  |



## CHAPTER III

### GENERAL STUDIES

A number of studies and general appraisals were conducted of TOPICS Program elements which involve all or major portions of the TOPICS System or major areas of the city and are described below.

#### CAPACITY ANALYSES

Capacity analyses were made at TOPICS Project Locations where alleviation of heavy congestion or undue delay to selected traffic movements were major justification for proposed improvements. See Exhibit 11. Capacity analyses were also made at other important locations which although not slated for TOPICS improvements are nevertheless of significance to insure that balanced route-segment capacities will be obtained as a result of adjacent TOPICS improvements. Volume-to-capacity (V/C) ratios are based upon current peak-hour flows in relation to capacity (Level of Service E). Capacity analyses methods used are set forth in the *Highway Capacity Manual*.\*

Volume-to-capacity ratio's above 0.50 indicate congested conditions, with delay increasing rapidly with modest increases in the V/C ratio. Nearly all locations to be improved through the TOPICS Program have a relatively high existing V/C. As shown in Exhibit 11, congested conditions extend along considerable sections of Orange, Brooks and Russell Streets, and Higgins Avenue with substantial relief being provided by proposed improvements. Note that the existing V/C for the two-lane Orange Street Bridge and Burlington Northern Railroad underpass do not prevent realization of overall route capacity improvement along Orange Street stemming from the proposed projects.

#### SIGNING

For the most part the signing on the Federal-Aid System and its approaches is extremely deficient. Very few regulatory and warning signs are reflectorized for good night visibility. State Highway route markers are very difficult to follow and, in some cases, incorrect in comparison to designated routes. Destination and guide signing has not been changed or removed following completion of new road construction projects. In some instances

\*Special Report 87, Highway Research Board, Washington, D.C., 1965.

## EXHIBIT NO. 11

### Selected Volume - To - Capacity Ratios\*

|               | <u>Location</u>               | <u>Volume-to-Capacity Ratio</u> |                     |
|---------------|-------------------------------|---------------------------------|---------------------|
|               |                               | <u>Existing</u>                 | <u>Proposed</u>     |
| Orange St. @  | BN RR Underpass               | 0.47                            | 0.47 <sup>(1)</sup> |
|               | Broadway                      | 0.80                            | 0.50                |
|               | Main & Front Streets          | 0.78                            | 0.42                |
|               | Clark Fork River Bridge       | 0.51                            | 0.51 <sup>(1)</sup> |
|               | So. 3rd Street                | 1.05                            | 0.49                |
|               | So. 5th Street                | 0.67                            | 0.39                |
|               | So. 6th Street                | 0.88                            | 0.36                |
| Brooks St. @  | Higgins Avenue & Eddy Avenue  | 0.76                            | 4-9's Project       |
|               | Stephens Avenue               | 0.72                            | 0.86 <sup>(3)</sup> |
|               | South Avenue & Russell Street | 0.73                            | 0.43                |
|               | Washburn Street               | (2)                             | 0.30                |
| Russell St. @ | Broadway                      | 1.10                            | 0.86                |
|               | So. 3rd Street                | 1.00                            | 0.61                |
| Broadway @    | Higgins Avenue                | 0.73                            | (1)                 |
|               | Madison Street                | 0.58                            | 0.40                |
|               | Van Buren Street              | 0.45                            | 0.35                |

\* Capacity calculated at level of service E.

(1) No proposed TOPICS improvement

(2) Presently unsignalized with negligible traffic on Washburn Street

(3) Used diverted traffic for analysis



otherwise adequate high-type directional signing is located so that traffic signal visibility is impaired (e.g., Broadway at Madison Street). See also SPEED LIMIT ZONES AND SIGNING, below.

The city has completed a sign inventory of the majority of streets, and the county is in the process of doing same. Safety funds are to be utilized for the replacement of the majority of sub-standard signs. The State should review their guide and destination signing on all State routes. Some signing modification and improvements for specific locations are indicated in the individual TOPICS project planning reports.

#### SPEED LIMIT ZONES AND SIGNING

In general speed limits are set too low throughout the city. There is no continuity of speed limit signing between the city and county. For example, on one segment of a street, a vehicle is restricted to 25 mph in one direction and 35 mph in the other direction.

The city should examine its policy of a "blanket" 25 mile-per-hour speed restriction, and after proper traffic engineering analysis set speed limits for street segments based upon customary traffic engineering analysis of conditions and characteristics such as 85th percentile speed, adjacent land use, roadway quality, sight distances, pedestrian and bicycle provisions, etc. A comprehensive speed limit signing program should then be developed for the entire urban area. This work is, however, beyond the scope of this TOPICS report.

#### STREET ILLUMINATION

Street illumination within the city is generally poor on all the streets on the Federal-Aid System. While some of the streets in the CBD and isolated segments of other streets are illuminated with mercury vapor fixtures to conform to ASA-IES design levels, the majority of streets are either illuminated with obsolete incandescent fixtures or have no lighting at all. Street illumination in the County within the urban area is virtually non-existent.

The city and county should establish design standards and develop a master plan for upgrading and lighting levels on all arterial streets. Street lighting improvements are included at most of the improvement locations contained herein.

#### RAILROAD CROSSINGS

As reported in Chapter I within the City of Missoula, the two operating railroads are the Burlington Northern and the Milwaukee Road. The BN has 2 trackage segments, the double mainline running east-west through the north part of the city, with a branch line

running from the mainline south to Darby. The Milwaukee Road maintains mainline trackage south of the Clark Fork River, again running east-west through the city.

Burlington Northern has no plans for either expansion or abandonment of any of their facilities in Missoula. They recently installed a hump yard in the northwest section of the city with approximately 6 movements per day through the city from the yard.

Within the city there are 2 at-grade crossings of the BN mainline trackage, Duncan and Van Evans. At Duncan, the protection consists of flashing lights to protect the double mainline. At Van Evans which is off the TOPICS System, protection consists solely of a stop sign with cross-bucks for 9 tracks.

The main problem for the BN is that pedestrians can wander freely through the yard because no crossing facilities are provided. An over-crossing at Scott Street would be beneficial from a railroad point of view, primarily to replace the sole pedestrian over-crossing which has been removed due to an accident.

The BN branch line crossing the Clark Fork River at Blanche St. and running down to Darby handles approximately 4 freight movements on Wednesdays and Saturdays only. There is 1 additional switching movement each day down and back from the industrial areas south of the river. Therefore, this line appears to have relatively light usage.

The railroad crosses at-grade the following TOPICS System streets: Toole Avenue, Spruce Street, Pine Street, Broadway, South 3rd Street, South 5th Street, South 6th Street, Knowles Street, Russell Street, South Avenue, the Brooks Street and Reserve Street intersection, and South 39th Street. Based upon all readily available accident information and field observation, no discernible accident hazard problem was detected at any of the locations other than that signs at some of the crossings are in bad state of repair and need replacing. From a vehicular traffic capacity standpoint, Broadway which carried 16,500 AADT, narrows to two-lanes from four-lanes at the crossing and should be widened. The widening will present little difficulty to their operation according to the BN representative except that the existing RR signal will have to be replaced.

The Milwaukee Road's yard facilities extend from Russell to Van Buren with at-grade crossings of their trackage at Hickory, California, Catlin and Curtis protected by flashing signals. Separated crossings are at Madison, Higgins, Russell and Reserve. All others are at-grade with only cross-bucks. They plan no abandonment or expansion of trackage, operate 6-7 thru one-way freights each day and 2 switching movements. In the next 5 years, 3 more scheduled freights may be added to bring the total to around 10 per day. None of the at-grade crossing locations are on the Type II System.

Other than the roadway widening at Broadway and the barrier problems presented by the mainlines, the railroad facilities do not represent much of a problem as concerns vehicle and pedestrian safety.

## EMERGENCY PRE-EMPTION SYSTEM

The City Fire Department has eight different fire lanes along which they can pre-empt traffic signals. The fire pre-emption is a "crash" all red system (no yellow clearance phase precedes display of the red indication), and all signals on a system are pre-empted and released at the same time causing unnecessary delay and increasing accident potential because of anxious motorists wondering if signals are malfunctioning. For example, one system is pre-empted for a period of time in excess of 3 minutes. Part of the system is hard-wired, and the rest is interconnected with telephone pairs.

At the outset of this study, the sole purpose of presenting this element of the signal system was to establish guidelines, fire routes, type of pre-emption equipment, and method of pre-emption (4-way all red or fire lane green) for approval by the city and State in order to assure continuity of all signal design endeavors.

A plan was presented to the city indicating various fire routes from the main station in the CBD to serve all zones in the city. The type of system proposed was a hard-wired cascading system controlled by time-delay circuitry at the intersection so that by pushing a single button a progressed fire lane green system can be achieved without causing undue delay to the motorist.

The City Fire Department effectively rejected the above scheme by suggesting many more routes and by desiring to approach the majority of the signals from different approaches - a philosophy of fire lane control with which we do not agree. However, accepting the philosophy of the city, a hard-wired system will *not* work for the number of proposed signals involved. The maintenance would be an extreme problem, and from an operations standpoint, the accident potential will be greater because of long delays and blockage of traffic than compared to *no* emergency pre-emption system. Even if it is pre-empted to a four-way all red operation in order to reduce the amount of circuitry and equipment, ultimately, the system would not work because of raised median channelization which will undoubtedly become more prevalent on major arterial streets such as Brooks Street (e.g., for a four-way all red system, the emergency vehicle has to cross the centerline to the opposite lanes prior to the intersection in order to pass the vehicles stopped at the red light).

Since no agreement could be reached on an emergency pre-emption system, no plans are

contained herein for approval.

It is strongly recommended at the city evaluate their present system and adopt a plan for signal pre-emption. However, based upon the city's desires, it is recommended that a system such as "Opticom", which operates on light waves and requires a transmitter in *all* emergency vehicles and receivers at *all* signalized locations, be installed and a funding program adopted to finance same. Finally, if the latter is accomplished, appropriate hardware at the intersections should be installed with the proposed TOPICS improvements. The cost estimates contained herein for the signalized intersections would be increased by approximately \$1,000.00 per intersection.

## SIGNAL SYSTEM INTERCONNECT

Although not specifically mentioned as a separate TOPICS Project in Chapter VI, interconnect wires between signals are included with each project. Ultimately, as signals are constructed, gaps in the interconnect will occur between some signals, thus, necessitating additional construction. A flexible master plan for interconnecting all signals should be developed in relation to the proposed illumination master plan. Conduit for interconnect circuitry should be placed where appropriate as new construction such as roadway widening and driveway and utility location is undertaken.

## BICYCLE ROUTES

Due to the increased use of bicycles, as a mode of transportation, especially by the student population, bicycle pathways and rights-of-way have become an important consideration in the planning and construction of new roadways and traffic engineering improvements. This is especially important for cities with colleges or universities because of the increased number of bicycles per capita. It therefore becomes increasingly important to provide these bicycle facilities to reduce conflict areas, increase safety, and provide for the adequate movement of both bicycle as well as vehicular traffic.

The University of Montana developed for the city a bicycle route system and published a report entitled, *The Proposed Missoula Bikeway System*, 1972. It is recommended that the city implement a bicycle system comparable to that contained in the report except that some of the bicycle routes should be altered to remove bicycles from the heavy traveled arterial streets. The city should coordinate all bicycle route planning and implementation with the Department of Highways to ensure that there are no conflicts on the proposed routes.

Since the bicycle plan has not been adopted by the city and, therefore, subject to revision,

no effort was made to coordinate TOPICS improvements with the bicycle route system. Bicycle route improvements can be implemented under the TOPICS Program, not by themselves, but in conjunction with the TOPICS Improvement Projects contained herein. Potential improvements might include:

- a. Signing
- b. Curbing and/or channelization
- c. Bicycle actuation at actuated signal locations
  - 1. Bicycle push button
  - 2. Bicycle actuation pads
- d. Bicycle paths and routes

## CENTRAL BUSINESS DISTRICT STUDY

The CBD occupies a major portion of the downtown area defined by Front, Orange, Railroad, and Adams Streets. Of the eleven presently signalized intersections within this area only two intersections meet current standards with regard to items such as signal display and visibility, pedestrian indications, and controller reliability. There is a limited signal interconnection system. Curb parking prohibitions are few and diagonal parking is present on some blocks. Eight intersections within this area are among the 36 intersections on the high-accident location list. Collision diagram analysis indicates that lack of signalization or poor visibility of signal heads are primary causes of accidents at these locations. Curb parking adjacent to intersections may also contribute significantly to accident experience. Separate left-turn lanes are not provided at any intersection within the CBD area. Street lighting in the core area has recently been upgraded with 700-watt mercury vapor luminaires, although outdated incandescent fixtures still exist on some streets.

A comprehensive CBD planning study is currently being conducted by others for the city and is expected to be completed in mid-1973. Therefore, proposed improvement locations in the present study have been confined to Orange Street between Main and Alder Streets since certain basic improvements are required on this street segment which are independent of any circulation and traffic improvements proposals which might issue from that study (see TOPICS Planning Report: Orange Street -- South of Broadway to Alder Street).

Prior to the city embarking on the CBD Development Plan, all inventory data was completed and is shown on Exhibit 12 (with the exception of manual turning movement counts), and the TOPICS analysis effort to determine potential improvements had commenced. Because of potential conflicts in circulation plans and proposed improvements with that study, all work from a TOPICS standpoint ceased by agreement with the State.

At that time, several one-way couplet concepts and street closures were developed, but not analyzed, so they are not presented herein.

Some basic observations and conclusions from our limited analysis are:

- a. All signals should be reconstructed
- b. A circulation system must be developed to provide capacity relief to the Higgins Avenue and Broadway intersection.
- c. If Front Street is to be retained as a one-way street, the segment between Ryman Street and Higgins Avenue must be converted from a two-way operation to one-way eastbound in order to reduce driver confusion, accident hazard, and congestion.
- d. Better and more convenient access should be provided to the parking facilities adjacent to the Clark Fork River (if it is the city's goal to utilize these lots for CBD patrons and workers). The access problem should be studied in relation to c) above.
- e. Diagonal parking should be removed from certain streets and, at the very least, should be restricted adjacent to the intersection area. The diagonal parking creates sight distance restrictions at the majority of the intersections, inhibits circulation on certain streets, and increases the accident potential (compared to parallel parking).
- f. Off-street parking facilities with good access must be provided.
- g. As already contained herein, Orange Street should be improved to accommodate the through traffic flow.

All or part of the above projects with the exception of (f) are eligible for TOPICS funding. Following the completion of the CBD Development Study, if the city desires to finance any of the above eligible projects or any other projects under the TOPICS Program, the city should submit a Project Planning Report to the State justifying the projects. At the same time, the city, by request and justification, can change the staging of the proposed projects contained in Chapter IV to allow immediate implementation (providing TOPICS funds are available). According to the priority analysis in Chapter IV, an overall CBD project should be in the Stage 1 program.





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## BROOKS STREET ("93 STRIP") ACCESS STUDY

The Missoula City Planning Department is currently conducting a land use, parking and circulation study of the commercial area adjacent to the Brooks Avenue (U.S. 93) from Mount Avenue south to the city limits. Under consideration are proposals to restrict access to Brooks Street, vacation of a number of minor streets, and the reestablishment of interior circulation by merchants. Proposed TOPICS improvements in the Brooks Street corridor described elsewhere in this report incorporate the city's objectives as defined at the present time and are consistent with TOPICS Program guidelines and constraints.

## OTHER TRANSPORTATION IMPROVEMENT NEEDS

During the course of the TOPICS inventory and analyses it became evident that several major projects, which are outside the scope and intent of the TOPICS Program, should be programmed for development in order to adequately carry the immediate traffic needs. Other alternatives may be available other than those proposed below, but any analysis is outside the scope of this study. Secondly, other projects may be equally important based upon changes in land use.

One of the purposes of the transportation study update should be to evaluate the arterial network in relation to projected traffic flows (both 1975 or 1980 and 1985 or 1990) in order to fully determine the adequacy of certain facilities in light of trip generation and changes in land use, population and economic trends and, perhaps, place construction priorities on the inadequate segment of arterial streets.

On the basis of traffic flow and overall circulation, it is recommended that the following streets be programmed for reconstruction by 1978.

Widen Russell Street to four-lanes between Broadway and South 3rd Street (this recommendation is somewhat in conflict with the Reserve Street project, but according to the O & D data and ensuing analysis contained in the Russell Street - Broadway and Russell Street - South 3rd Street Planning Report, Reserve Street will only remove 4000 to 5000 vehicles from this segment of Russell Street based upon 1972 volumes).

Widen the Orange Street Bridge to four-lanes across the Clark Fork River.

Construct an overpass across the BN Railroad Tracks in the vicinity of Scott Street or Russell Street (presently the route on Orange Street and North 3rd Street and the Frontage Road is the only access to the industrial area. This project would remove

about 30-40% of the traffic load from Orange Street between Broadway and North 3rd Street).

Widen Broadway to five-lanes between east of Russell Street and May Street.

Widen Russell Street between South 3rd Street and Brooks Street.



## CHAPTER IV

### FEDERAL-AID SYSTEM REVIEW AND IMPLEMENTATION PROGRAM

#### FAP I AND FAS REVIEW

Possible system changes for the Primary Type I and the Secondary Systems were studied in conjunction with the Tentative Type II System, the existing street network and traffic generators, importance to the County and State, proposed circulation system contained in the transportation plan, and the present State Highway System Routings.

At the present time considering the State Routes and availability of good, recent Origin and Destination information, no additions or deletions are recommended for the FAP I or FAS Systems.

As contained in the contract, the possibility of removing Brooks Street and Higgins Street between Stephens Avenue and the 5th Street-6th Street one-way couplet was reviewed. The new FAP Route would coincide with the spur FAP 7 on Stephens Avenue-Orange Street to the 5th Street-6th Street couplet and then turn east along the couplet.

In order to evaluate the impact of this change on the new system, volume assignments were made utilizing 1971 AADT volumes as well as information relating to travel patterns contained in the 1985 Urban Transportation Plan.

As a result of this analysis a minimum of an additional 3200 vehicles/day can be assigned to the new route (Stephens Avenue) from Brooks Avenue. One primary assumption made to arrive at the reassigned value is that all through traffic using U.S. 93 travels the Stephens-Orange Route. However, the above assumption is not true in that route markers presently on the street direct a motorist to Higgins Avenue-Brooks Street Route from *both* the Orange Street interchange and Brooks Street South of Stephens Avenue. The net result would be that, compared to present day AADT volumes, the net diversion could be greater than 5000 vehicles per day, which would create a greater imbalance of traffic flows on the two streets than presently exists (See Exhibit 7). Therefore, because of the heavy left turn movement at Stephens Avenue, this intersection would then be operating at or over the capacity of the intersection (assuming the design contained herein is implemented). The intersection should be designed for two left-turn lanes and four through lanes, and right-of-way is not available for same.

Secondly, by crossing all the traffic at Higgins Avenue on 5th and 6th Streets, the capacity of Higgins Avenue will be decreased and progression possibilities, which means more delay, will be substantially reduced.

Thirdly, prior to suggesting FAP changes, the State Routes must be examined in a heavily populated urban area for continuity, ease of movement, capacity on facilities, adjacent land use, traffic mixture, interference with other major traffic generators, etc. Neither of the two routes is particularly good when examined on the above criteria.

Therefore, in regards to the State routing, diversion of traffic, capacity of facilities, and land uses, it is our recommendation that U.S. 93 remain as is (Stephens Street-Orange Street) and Brooks Street-Higgins Avenue-South 5th and South 6th Streets-Madison Street-Broadway remain as U.S. 12, and the section on Higgins Avenue between South 6th Street and Broadway remain as U.S. 12 Business. Following completion of Reserve Street, Reserve Street between Brooks Street and Interstate 90 be designated as U.S. 12 and U.S. 93, and Brooks Street-Stephens Avenue-Orange Street be designated as U.S. 12 and U.S. 93 Business.

In line with the above recommendations, the FAP System remains the same, and in the future, Reserve Street would become a FAP Route, Brooks Street-Stephens Street-Orange Street would remain on the FAP System, Reserve Street would be removed from the FAS System, and Brooks Street-Higgins Avenue-5th and 6th Streets-Madison Street would be removed from the FAP System.

Finally, it is our recommendation that the FAP System routing and State routing be restudied as part of the transportation study update when better definitive data can be collected and analyzed than what presently exists for 1972 traffic patterns so that alternatives can be carefully evaluated.

#### FAP II REVIEW

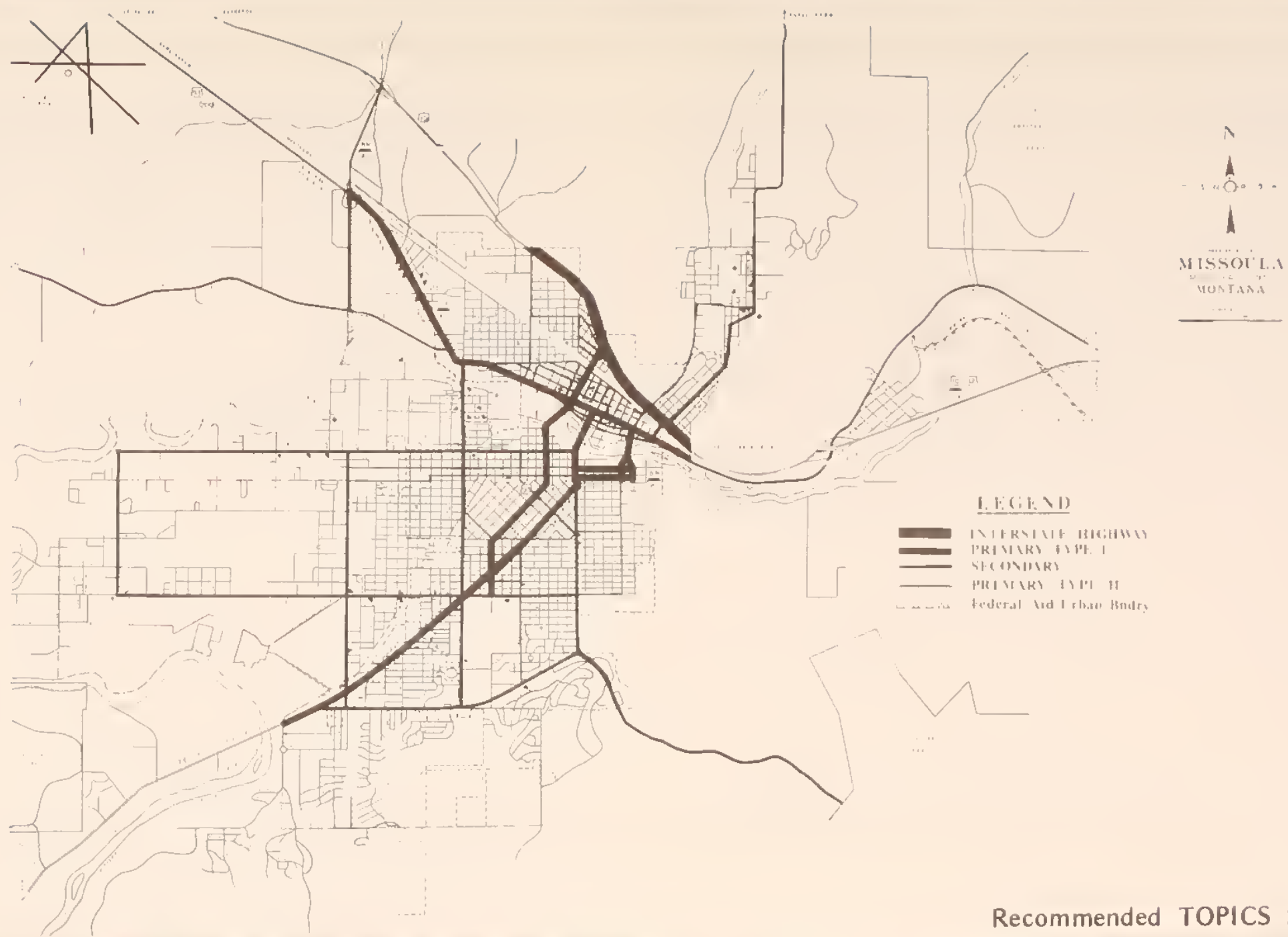
The Tentative Type II System was developed jointly by the city and State, and was modified during the course of the study. It is recommended that the following revisions as shown on Exhibit 14, Recommended TOPICS System, which is summarized by mileage on Exhibit 13, be made to this system:

Add North 3rd Street from Orange Street to Worden Street.  
Reason: Forms one-way couplet with North 2nd Street.

Add the Frontage Road West of Orange Street.

# EXHIBIT NO. 13 TOPICS System Mileage

| <u>Federal Aid Interstate</u>           | <u>Miles</u> | <u>Percent of System</u> | <u>Federal Aid Primary Type II (Cont.)</u> | <u>Miles</u> | <u>Percent of System</u> |
|-----------------------------------------|--------------|--------------------------|--------------------------------------------|--------------|--------------------------|
| Interstate Highway 90                   | 2.20         | 3.7%                     | Adams Street                               | 0.30         |                          |
| Federal Aid Primary Type I              |              |                          | Washington Street                          | 0.34         |                          |
| Broadway Street                         | 3.92         |                          | Pattee Street                              | 0.38         |                          |
| Orange Street                           | 1.42         |                          | Higgins Avenue                             | 0.23         |                          |
| Stephens Street                         | 1.16         |                          | Ryman Street                               | 0.40         |                          |
| Brooks Street                           | 2.92         |                          | Woody Street                               | 0.36         |                          |
| Higgins Avenue                          | 0.60         |                          | Owen Street                                | 0.34         |                          |
| Madison Street                          | 0.38         |                          | Scott Street                               | 0.98         |                          |
| Maurice Avenue                          | 0.13         |                          | Stoddard Street                            | 0.42         |                          |
| South 5th Street                        | 0.51         |                          | Worden Street                              | 0.25         |                          |
| South 6th Street                        | 0.51         |                          | Frontage Road - N/o Orange St.             | 0.36         |                          |
| Arthur Avenue                           | 0.08         |                          | North 3rd Street                           | 0.25         |                          |
|                                         | 11.68        | 19.8%                    | North 2nd Street                           | 0.19         |                          |
| Federal Aid Secondary                   |              |                          | Railroad Street                            | 0.72         |                          |
| Van Buren Street/East Rattlesnake Drive | 1.97         |                          | Toole Avenue                               | 0.76         |                          |
| South 3rd Street                        | 3.94         |                          | Alder Street                               | 0.57         |                          |
| South Avenue                            | 3.98         |                          | Spruce Street                              | 1.06         |                          |
| South Higgins                           | 1.48         |                          | Pine Street                                | 1.12         |                          |
| Pattee Canyon Drive                     | 0.70         |                          | Main Street                                | 0.61         |                          |
| S.W. Higgins Avenue                     | 1.00         |                          | Front Street                               | 1.04         |                          |
| 39th Street                             | 1.25         |                          | South 5th Street                           | 2.01         |                          |
| Russell Street                          | 2.97         |                          | South 6th Street                           | 1.25         |                          |
| Reserve Street                          | 3.45         |                          | Garfield Street                            | 0.04         |                          |
| Clements Street                         | 1.25         |                          | South 7th Street                           | 0.72         |                          |
| Mullen Road                             | 0.95         |                          | Beckwith Street                            | 1.08         |                          |
|                                         | 22.94        | 38.8%                    | Walnut Street                              | 0.23         |                          |
| Federal Aid Primary Type II             |              |                          | Hill Street                                | 0.04         |                          |
| Lolo Street                             | 0.51         |                          | Mount Avenue                               | 0.68         |                          |
| Duncan Drive                            | 1.02         |                          | Strand Avenue                              | 0.42         |                          |
| Madison Street                          | 0.15         |                          | Knowles Street                             | 0.34         |                          |
| Jefferson Street                        | 0.18         |                          | Central Avenue                             | 0.36         |                          |
|                                         |              |                          | South Avenue                               | 0.40         |                          |
|                                         |              |                          | Arthur Avenue                              | 1.04         |                          |
|                                         |              |                          | Bancroft Street                            | 0.95         |                          |
|                                         |              |                          | Washburn Street                            | 0.12         |                          |
|                                         |              |                          | Dearborn Avenue                            | 0.10         |                          |
|                                         |              |                          |                                            | 22.32        | 37.7%                    |
|                                         |              |                          | SYSTEM TOTAL                               | 59.14        | 100.0%                   |



Recommended TOPICS System

EXHIBIT NO. 14

Reason: Truck Route to Industrial Area north of Railroad Tracks and proposed to be used as part of a one-way couplet with North 3rd Street.

Delete Duncan Drive north of Lolo Street. Add Lolo Street between Duncan Drive and Brayton Street.

Reason: Duncan Street disappears into a dirt road north of Highland. Residential area adjoins Duncan Street between Lolo and Highland. Lolo Street is the only street in the Rattlesnake drainage area that connects Duncan Drive with Brayton Street.

Delete Evans Street between Higgins Avenue and Arthur Avenue. Add Beckwith Avenue between Higgins Avenue and Arthur Avenue and add Hill Street between Mount Avenue and Higgins Avenue.

Reason: Beckwith Avenue connects directly into the college campus parking lots and the peripheral road to the east of the campus. Through proper development of the intersection at Higgins Avenue, a double "T" condition can be avoided at Arthur Avenue and prevent vehicles feeding through residential areas.

Add Knowles Street between Russell Street and Stephens.

Reason: Knowles Street provides an alternate route from Russell Street to the commercial area along Brooks and to the southeast area of the city. Left-turns at South Avenue from Russell Street are presently prohibited.

Add Strand Avenue between Russell Street and Bancroft Street.

Reason: Upon analysis of street configurations, adjacent land uses, proposed land uses, and street vacations, Strand Street forms the best northern street boundary to the commercial area and improves access to the major traffic generators in the Brooks Street corridor and to the planned and soon-to-be constructed U.S. Post Office, which is to be located on the vacant land bounded by Keot, Oxford, Kensington and Regent Streets.

Add Central Avenue between Brooks Street and Bancroft Street.

Reason: Based upon present and proposed land use changes and the Brooks Street Access Study, Central Avenue forms the best southern street boundary to the commercial areas as proposed herein. The intersection of Brooks Street and Central Avenue will be signalized.

Delete North 2nd Street and Worden Street between Orange Street and North 3rd Street.

Reason: If the city accepts Alternate B for the proposed Orange Street project, North 2nd Street reverts to a local access street. If the city accepts Alternate A, North

2nd Street would remain on the system.

Add Scott Street between Toole Avenue and Stoddard Street.

Reason: Although the street is not constructed across the BN Railroad tracks, the Scott Street right-of-way does extend across the tracks. The addition of this segment of Scott Street provides continuity of the route, and potentially allows for a second access point into the industrial and residential area north of the railroad tracks.

None of the streets in the CBD were examined. Following the completion of the city CBD Development Study, and the recommendations therefrom, the TOPICS System in the CBD Area should be reevaluated at that time.

## PROJECT ARRAY

The projects recommended in this study were evaluated as to priority using a cost-effectiveness technique. All potential projects were analyzed using a logical set of parameters whereby the improvements can be rated in a systematic sequence that establishes a general array for implementation.

The existing deficiency parameters include:

- Capacity
- Number of Accidents and Accident Rate
- Number of Conflict Points - Hazard Potential for Accidents
- Travel Time (Delay)
- Pedestrian and Bicycle Activity
- Route Continuity and Importance to the Street Network
- Geometric Configuration of the Street and Intersections, and Conformance to MUTCD

These elements were chosen because they reflect best the types of projects eligible for TOPICS participation and yet allow a judgment as to the significance of the improvement to the highway network and the transportation planning process. Each of the above parameters are weighted equally without emphasis of one over another.

Each project is analyzed according to each of the above parameters, and a numerical value, either zero, one, three or five, will be assigned to that project to indicate the severity of the existing deficiency. For example, a proposed improvement with a particularly severe overall situation could have a maximum of thirty-five deficiency points. The points method stipulates that the higher the total, the worse the existing condition. Therefore, a basic



assumption is that if the project is constructed therein lies the potential for the removal of the deficiency points.

Traffic volume is placed into the analysis to indicate the use of a facility. In effect, a weighting factor is applied to each project. The last input into this system is that of cost. Ultimately, what is derived from these inputs are cost effective projects if the deficiency points, AADT, and costs are considered in the following manner:

$$\text{COST EFFECTIVE RATE} = \frac{(\text{D.P.})(\text{AADT})}{\text{COST}}$$

By using this method it is possible to array the potential projects in a manner that should be indicative of the most beneficial projects. It should be noted here that it was decided to use this approach in lieu of the standard benefit-cost analysis because, in our opinion for planning purposes, the application of intangihle monetary values such as delay costs and accident reduction costs to hypothesized benefits such as predicted accident reduction or accident hazard elimination is inappropriate and that cost-effectiveness is more indicative of capacity and safety improvements.

The cost-effectiveness technique produces the array shown in Exhibit 15 which provides a general indication of the relative importance of the projects.

IMPLEMENTATION

The final Recommended TOPICS Implementation Program is developed on the basis of the project array in Exhibit 16 and with further consideration given to the following criteria, not necessarily in the order shown:

- Construction Cost
- Current Maintenance Problems and Costs
- System Flexibility in Relation to Other Projects
- Immediate Influence Upon Arterial Network

Therefore, the projects are staged and only general priorities have been assigned to each project. Projects that perhaps may not be eligihle for TOPICS funding but, otherwise are important for highway safety and network circulation are listed in the third stage. During the continuing phase of the TOPICS Program, these projects in the third stage should be reviewed with the other projects listed in stage two along with any other problem areas that have developed in the interim. The recommended staging of projects is shown in Exhibit 16.

All projects listed in Improvement Projects previously programmed are early implementation improvements that have been submitted to the FHWA for review and approval and currently either have been approved, have been advertised for construction or are under construction. Since Project Planning Reports have been written and approved, they are not contained herein; however, a brief description including the scope of work and cost estimate of each project is reported.

Complete Project Planning Reports have been developed for all TOPICS Projects and are reported in Chapter VI. These Project Planning Reports contain all the information necessary for project approval by the State and FHWA so that when TOPICS funds become available, engineering design work may proceed immediately following FHWA approval of the Areawide TOPICS Plan without submitting additional Project Reports.

Projects listed in the Summary of Additional Spot Improvement Projects are briefly described in Chapter VII. During the continuing phase, if these projects are elevated in priority, if additional TOPICS funds become available, or if traffic growth justifies a project, full Project Planning Reports should be submitted at that time in order to construct the projects with TOPICS funds. Also included in this chapter are projects that are inexpensive or probably not eligible for TOPICS funding that should be considered for implementation using local funds or on force account.



# EXHIBIT NO. 15 Cost Effectiveness Array

| Project                                                                 | Total<br>Deficiency<br>Points | AADT<br>Affected | Cost      | Cost<br>Effectiveness | Project                                            | Total<br>Deficiency<br>Points | AADT<br>Affected | Cost    | Cost<br>Effectiveness |
|-------------------------------------------------------------------------|-------------------------------|------------------|-----------|-----------------------|----------------------------------------------------|-------------------------------|------------------|---------|-----------------------|
| Broadway at Toole &<br>Broadway at Cedar                                | 10                            | 21,000           | 5,000     | 42                    | e. Brooks Street-<br>Kensington-Holborn            | 23                            | 17,000           | 33,000  | 12                    |
| Brooks & Beckwith<br>Stephens & Beckwith                                | 9                             | 25,000           | 4,000     | 28                    | f. Brooks Street-Strand-<br>Bow-Burlington         | 23                            | 17,000           | 57,000  | 7                     |
| Broadway & Van Buren                                                    | 18                            | 13,500           | 9,000     | 27                    | g. Brooks Street-Mount-<br>Bancroft                | 21                            | 17,000           | 52,000  | 7                     |
| Russell & 11th Street                                                   | 14                            | 14,000           | 10,000    | 20                    | h. Stephens Avenue-Strand<br>Avenue                | 17                            | 11,000           | 32,000  | 6                     |
| School Protection Crossing                                              | 22                            | 75,000           | 84,000    | 20                    | i. Stephens Avenue-Mount-<br>Knowles               | 19                            | 12,000           | 48,000  | 5                     |
| 6th & Arthur Signal System                                              | 19                            | 13,500           | 16,000    | 16                    | j. Russell Street-Kent<br>Avenue                   | 12                            | 13,000           | 12,000  | 78                    |
| Orange Street and<br>Broadway to Alder                                  | 28                            | 28,000           | 52,000    | 15                    | k. Russell Street-Strand<br>Avenue                 | 14                            | 13,000           | 2,000   | 91                    |
| Broadway & Madison                                                      | 24                            | 24,000           | 41,000    | 14                    | Russell Street & S. 39th                           | 16                            | 11,000           | 35,000  | 5                     |
| Orange, Main & Front<br>Signalization                                   | 28                            | 22,000           | 43,000    | 14                    | 3rd, 5th, 6th & Orange<br>Widening & signalization | 26                            | 25,500           | 124,000 | 5                     |
| Orange Street                                                           | 23                            | 16,500           | 29,000    | 13                    | Higgins & South<br>Signalization                   | 10                            | 16,000           | 34,000  | 5                     |
| R.R. Underpass to N. 3rd                                                |                               |                  |           |                       | 5th, 6th and Russell<br>Widening & signalization   | 13                            | 20,000           | 65,000  | 4                     |
| Russell Street                                                          | 30                            | 53,000           | 121,000   | 13                    | Brooks Street & Reserve                            | 16                            | 12,500           | 66,000  | 3                     |
| S. 3rd & Russell & Broadway                                             |                               |                  |           |                       | South and Reserve                                  | 8                             | 10,000           | 25,000  | 3                     |
| CBD                                                                     | 28                            | 60,000           | 150,000** | 11                    | Madison and Spruce                                 | 4                             | 6,000            | 10,000  | 2                     |
| Arthur & Beckwith<br>Signal System                                      | 18                            | 11,500           | 19,000    | 11                    | Van Buren and Missoula                             | 7                             | 5,000            | 25,000  | 1                     |
| Broadway & Burlington<br>Northern R.R. tracks<br>near Blanche Street    | 22                            | 16,500           | 41,000    | 9                     | Van Buren & Wylie                                  |                               |                  |         |                       |
| Higgins, Mount, Beckwith<br>and Hill                                    | 20                            | 12,000           | 36,000    | 7                     |                                                    |                               |                  |         |                       |
| Mount, Higgins, Russell<br>with diagonal streets                        | 7                             | 25,000           | 24,000    | 7                     |                                                    |                               |                  |         |                       |
| Higgins & Pattee Canyon                                                 | 7                             | 8,000            | 8,000     | 7                     |                                                    |                               |                  |         |                       |
| Brooks, Russell & Stephens<br>Commercial Area                           |                               |                  | 630,000   | (11)*                 |                                                    |                               |                  |         |                       |
| a. Brooks Street-Russell-<br>South, includes left turn<br>intersections | 31                            | 40,000           | 248,000   | 5                     |                                                    |                               |                  |         |                       |
| b. Brooks Street, Oxford &<br>Sussex                                    | 23                            | 20,000           | 32,000    | 14                    |                                                    |                               |                  |         |                       |
| c. Brooks Street, Central-<br>Regent-Kent                               | 25                            | 22,000           | 65,000    | 8                     |                                                    |                               |                  |         |                       |
| d. Brooks Street-Stephens<br>Avenue                                     | 28                            | 24,000           | 59,000    | 11                    |                                                    |                               |                  |         |                       |

\* Relative average of all projects

\*\* Assumed cost figure for reconstructing seven signals

# EXHIBIT NO. 16

## Project Staging

### IMPROVEMENT PROJECTS PREVIOUSLY PROGRAMMED

| Stage | Project Location       | Work Description          | Cost      | Total Stage Cost |
|-------|------------------------|---------------------------|-----------|------------------|
| I     | 6th & Arthur           | Signalization             | \$ 16,000 |                  |
|       | Arthur & Beckwith      | Signalization             | 19,000    |                  |
|       | Orange, Main & Front   | Signalization             | 43,000    |                  |
|       | 5th & 6th & Russell    | Widening & Signalization  | 66,000    |                  |
|       | 3rd, 5th, 6th & Orange | Widening & Signalization  | 197,000   |                  |
|       | Higgins & South        |                           | 34,000    |                  |
|       | Broadway-Burlington    | Widening & Channelization |           |                  |
|       | Northern RR Tracks     |                           | 100,000   |                  |
|       | TOTAL STAGE I          |                           |           | \$475,000        |

### TOPICS PROJECT PLANNING REPORTS

|    |                                                                                                                |                                            |           |
|----|----------------------------------------------------------------------------------------------------------------|--------------------------------------------|-----------|
| II | Orange St. Brdwy-Alder                                                                                         | Widening & Signalization                   | \$ 52,000 |
|    | Orange St. RR to N. 3rd                                                                                        | Widening & Channelization                  | 29,000    |
|    | Brooks-Russell-Stephens Com'l Area                                                                             |                                            |           |
|    | a. Brooks-Russell-South including South & Washburn, Brooks & Dearborn, Dearborn & Russell & left turn signing. | Signalization<br>Widening & Channelization | 248,000   |
|    | b. Brooks Street Oxford & Sussex                                                                               | Widening & Channelization                  | 32,000    |
|    | c. Brooks Street Central-Regent-Kent Kent                                                                      | Widening & Signalization, Channelization   | 65,000    |
|    | d. Brooks Street Stephens                                                                                      | Widening Channel Resignalization           | 59,000    |

| Stage         | Project Location                       | Work Description                         | Cost      | Total Stage Cost |
|---------------|----------------------------------------|------------------------------------------|-----------|------------------|
| II<br>(Cont.) | e. Brooks Street Kensington-Holborn    | Widening & Channelization                | \$ 33,000 |                  |
|               | f. Brooks Street Strand-Bow-Burlington | Widening & Channelization, Signalization | 57,000    |                  |
|               | g. Brooks Street Mount-Bancroft        | Widening, Signalization & Channelization | 52,000    |                  |
|               | h. Stephens Avenue Strand              | Signalization                            | 32,000    |                  |
|               | i. Stephens Avenue Mount-Knowles       | Widening, Signalization & Channelization | 48,000    |                  |
|               | j. Russell-Kent                        | Widening & Channelization                | 2,000     |                  |
|               | k. Russell-Strand                      | Widening & Channelization                | 2,000     |                  |
|               | Russell - So. 39th                     | Widening, Channelization & Signalization | 35,000    |                  |
|               | Russell - 11th                         | Widening & Channelization                | 10,000    |                  |
|               | Russell - So. 3rd                      | Widening & Channelization                | 121,000   |                  |
|               | Russell - Broadway                     | & Resignalization                        |           |                  |
|               | Broadway - Van Buren                   | Channelization & Resignalization         | 9,000     |                  |
|               | Broadway-Madison                       | Channelization & Resignalization         | 41,000    |                  |
|               | Higgins-Mount-Beckwith-Hill            | Widening, Channelization & Signalization | 36,000    |                  |
|               | Brooks-Reserve                         | Signalization                            | 66,000    |                  |
|               | School Protection Devices CBD          | Signalization & Signing                  | 84,000    |                  |
|               |                                        | Signalization                            | 150,000*  |                  |
|               | TOTAL STAGE II                         |                                          |           | 263,000          |
|               |                                        |                                          |           | \$1,263,000      |

\* Assumed cost figure for reconstructing seven signals

**EXHIBIT NO. 16 ( Cont d )**  
**Project Staging**

| <u>Stage</u>                                    | <u>Project Location</u>                                | <u>Work Description</u>      | <u>Cost</u> | <u>Total<br/>Stage Cost</u> |
|-------------------------------------------------|--------------------------------------------------------|------------------------------|-------------|-----------------------------|
| SUMMARY OF ADDITIONAL SPOT IMPROVEMENT PROJECTS |                                                        |                              |             |                             |
| III                                             | South-Reserve                                          | Future<br>Signalization      | \$ 25,000   |                             |
|                                                 | Brooks-Beckwith-<br>Stephens-Beckwith                  | Loop Detectors               | 4,000       |                             |
|                                                 | Mount-Higgins-<br>Russell with all<br>diagonal streets | Channelization               | 24,000      |                             |
|                                                 | Broadway-Toole                                         | Channelization               | 5,000       |                             |
|                                                 | Broadway-Cedar                                         |                              |             |                             |
|                                                 | Higgins-Pattee Canyon                                  | Widening &<br>Channelization | 8,000       |                             |
|                                                 | Van Buren-Missoula                                     | Channelization               | 25,000      |                             |
|                                                 | Van Buren-Wylie                                        |                              |             |                             |
|                                                 | Madison-Spruce                                         | Channelization               | 10,000      |                             |
|                                                 | TOTAL STAGE III                                        |                              |             | <u>\$ 101,000</u>           |
|                                                 | TOTAL COST ALL PROPOSED TOPICS IMPROVEMENTS            |                              |             | <u>\$1,839,000</u>          |

CHAPTER V

IMPROVEMENT PROJECTS PREVIOUSLY PROGRAMMED

TRAFFIC IMPROVEMENT PROJECTS  
UNDER CONSTRUCTION, ADVERTISED AND/OR AUTHORIZED

SIXTH AND ARTHUR

Scope of Work: Remove existing flashers and replace with a new signal, and incorporate existing illumination system into a new signal.

Cost estimate: \$16,000.00

Funding is proposed under TOPICS.

ARTHUR AND BECKWITH

Scope of Work: Install a new signal and revise street lighting. Construct street widening involving increasing the curb radii and raising drop inlets.

Cost estimate: \$19,000.00

Funding is proposed under TOPICS.

ORANGE STREET, MAIN STREET AND FRONT STREET

Scope of Work: Traffic signal modificatinn including new traffic signal controller, new traffic signal poles and street lights. New roadway construction to improve turning radius at corners and to facilitate left-turn lanes. Reconstruction of median island to remove hazards.

Cnst estimate: \$43,508.00

This project is being let under TOPICS.

RUSSELL STREET AT 5TH STREET AND 6TH STREET

Scope of Work: Install 2-phase semi-actuated controller with presence detection nn

5th Street. Install traffic signal system with mast arm poles. Install street lighting system nn Russell Street. Construct roadway widening and curb and gutter. Remove parallel parking.

Cost estimate: \$65,580.00

This project is being let under TOPICS.

ORANGE STREET AT 3RD STREET TO STEPHENS AVENUE

Scope of Work: Construction of new curb and gutter and roadway improvements to widen Orange Street to four through lanes with left-turn lanes. Install new street lighting system. Remove parallel parking on Orange Street. Install new traffic signal system to replace existing systems at Orange and 3rd, 5th and 6th Streets with interconnect system. Installation will conform to the *Manual on Uniform Traffic Control Devices*.

Cost estimate: \$197,000.00

Funding is proposed under TOPICS.

HIGGINS AVENUE AND SOUTH AVENUE

Scope of Work: Install new traffic signal system utilizing mast arm signals and 2-phase semi-actuated controller with presence detection on Higgins Avenue. Construct roadway widening to accommodate two through lanes and left-turn lanes on both streets. Remnve diagonal parking on southwest corner.

Cost estimate: \$34,112.00

Funding is proposed under TOPICS.

EDDY AND HIGGINS AT 4TH, 5TH, AND 6TH

Scope of Work: At 4th Street and Higgins Avenue a 2-phase semi-actuated controller will be installed that will be interconnected to 5th, 6th, and Brooks Streets. Fifth, 6th and Brooks Streets will all have 2-phase fixed time controllers. The traffic signals will be upgraded to mast arm signals conforming to the *Manual on Uniform Traffic Control Devices*

\*U.S.D.O.T., F.H.W.A., *loc.*, *cit*

Cost estimate: \$68,000.00

This is a proposed 4-9's project.

**BROADWAY AND BURLINGTON NORTHERN RR TRACK NEAR BLANCHE STREET**

Scope of Work: Widen and install railroad signals at BN Railroad crossing and widen roadway to four lanes.

Purpose: The purpose of this project is to alleviate a bottleneck which now exists at the railroad tracks and to widen the roadway pavement to accommodate four (4) lanes from 300' ± east of the RR tracks to west of Toole Avenue to match the existing four lanes.

Cost Estimate: \$100,000.00

Funding is proposed under TOPICS.

**BROADWAY AND ORANGE AVENUE**

Scope of Work: Install a new signal system with street lighting. Construct street widening involving increasing curb radius.

Cost estimate: \$18,000.00

Funding is under a proposed 4-9's project

|                     |           |
|---------------------|-----------|
| Summary of Funding  |           |
| TOPICS Projects     | \$475,000 |
| Non-TOPICS Projects | 86,000    |



CONVENTIONAL SYMBOLS

| <u>MUTCH NO.</u>                                                                    | <u>SIGN MESSAGE</u>                                | <u>MUTCH NO.</u>                                                                     | <u>SIGN MESSAGE</u>                                                       |
|-------------------------------------------------------------------------------------|----------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| R1-1                                                                                | STOP                                               |   | Inductive Loops                                                           |
| R1-2                                                                                | YIELD                                              |   | Street Light                                                              |
| R3-1A                                                                               | NO RIGHT TURN                                      |   | Programmed Visibility Signal Head                                         |
| R3-2                                                                                | NO LEFT TURN                                       |   | Traffic Signal Pole with Signal Heads, Pedestrian Heads and Street Lights |
| R3-3                                                                                | NO TURNS                                           |   | Relocated or Proposed Storm Drain                                         |
| R3-5                                                                                | LEFT ONLY                                          |   | Existing Storm Drain                                                      |
| R3-5R                                                                               | RIGHT ONLY                                         |   | Shrubs                                                                    |
| R3-6                                                                                | OPTIONAL LEFT TURN - STRAIGHT THROUGH              |   | Existing Signing                                                          |
| R3-6R                                                                               | OPTIONAL RIGHT TURN - STRAIGHT THROUGH             |  | Right-Of-Way                                                              |
| R3-7                                                                                | LEFT LANE MUST TURN LEFT                           |                                                                                      |                                                                           |
| R3-7R                                                                               | RIGHT LANE MUST TURN RIGHT                         |                                                                                      |                                                                           |
| R3-8                                                                                | DOUBLE TURN                                        |                                                                                      |                                                                           |
| R4-7                                                                                | KEEP RIGHT                                         |                                                                                      |                                                                           |
| R5-1                                                                                | DO NOT ENTER                                       |                                                                                      |                                                                           |
| R6-1                                                                                | ONE WAY                                            |                                                                                      |                                                                           |
| R7-1                                                                                | NO PARKING ANYTIME                                 |                                                                                      |                                                                           |
| W1-6                                                                                | ALIGNMENT CHANGE RIGHT                             |                                                                                      |                                                                           |
| W1-7                                                                                | ALIGNMENT CHANGE LEFT AND RIGHT                    |                                                                                      |                                                                           |
| W3-3                                                                                | SIGNAL AHEAD                                       |                                                                                      |                                                                           |
| W14-1                                                                               | DEAD END                                           |                                                                                      |                                                                           |
|  | Proposed Signing                                   |                                                                                      |                                                                           |
|  | Roadway Construction                               |                                                                                      |                                                                           |
|  | Curb & Gutter or Type "B" Curb (See Constr. Notes) |                                                                                      |                                                                           |
|  | Guard Rail                                         |                                                                                      |                                                                           |
|  | Controller                                         |                                                                                      |                                                                           |



# CHAPTER VI

## TOPICS PROJECT

### PLANNING REPORTS AND EXHIBITS

#### TOPICS IMPROVEMENT PROJECT

Orange Street: South of Broadway to Alder Street

#### INTRODUCTION

Orange Street is a key north-south arterial in Missoula providing the only direct connection between Interstate 90, the CBD, and areas to the south of the Clark Fork River and presently carries an AADT of 9,800 vehicles north of Broadway. The project location includes intersections with Broadway (16,500 AADT), Pine Street (3,700 AADT) and Spruce Street (5,600 AADT).

Orange Street is the western boundary of the main retail core of the Central Business District and will be included in the CBD Study. However, due to its city-wide circulation function, access feeder function to the industrial area north of the railroad tracks, the end constraints at the Clark Fork River and the Burlington Northern Railroad line and the I-90 interchange location; Orange Street should not be converted to a one way couplet with any adjacent parallel street; therefore, the proposed improvement contained herein will fit into any proposed improvement of the Central Business District.

The Orange Street Roadway width between Broadway and Spruce Street varies from 48 feet to 66 feet and is for the most part uncurbed. With parking permitted, Orange Street essentially operates as a wide two-lane street. North of Alder Street, the roadway narrows and is two-lanes at the Burlington Northern Railroad line; south of Broadway Orange Street operates as a four-lane facility. Since the signal pole foundation on the southwest corner protrudes into the roadway, there is not sufficient width to stripe a left turn lane.

An existing fixed time signal operates at the Broadway Intersection which is totally inadequate: The signal pole installations encroach into the roadway and are constantly being hit; vehicle signals are top mounted which is not uniform with the signal display at Spruce Street, pedestrian signals are not provided, and the controller, which is single dial non-expandable, is in a bad state of repair. A semi-actuated signal, which has an adequate vehicle signal display and pedestrian signals, has recently been installed at Spruce Street. The Pine Street intersection is unsignalized.

#### JUSTIFICATION

Although all turning movement flows are less than 150 vehicles during the peak hour, unnecessary traffic delays occur at all approaches on Orange Street due to lack of turning lanes, parking, minimal corner radii, and offset curb alignments.

The proposed widening and removal of curb parking on Orange Street will reduce vehicular delay and improve overall traffic safety. Capacity analyses indicates that the proposed improvements will reduce the volume-to-capacity ratio (V/C) at Broadway from the present level of 0.66 to 0.50. These improvements are consistent with the program presented herein to make Orange Street a continuous multilane facility with each section having the same relative capacity.

Accident experience for the two-year period 1970-1971 generally reflects the above conditions plus inadequate visibility of existing signals at Broadway. With 31 accidents, the Broadway intersection is ranked second in the city in terms of both total accidents and accident rate. Right-angle collisions are predominant. Nineteen accidents at Pine Street places it fifth for accident rate and tenth for total accidents. Nearly all the accidents at Pine Street are right-angle collisions. Only four accidents were reported for the Spruce Street intersection.

The proposed signals at Pine Street are warranted by the accident experience under warrant Number 6. See warrant sheet.

#### SCOPE OF WORK

Reconstruct Orange Street between Broadway and Spruce Street by widening in amounts varying from 10 feet to 15 feet and constructing curb and gutter. Prohibit parking in order to provide for four through lanes plus a left-turn lane at all intersections creating the same relative capacity through the signalized intersections. The roadway widening transitions to the existing width north of Spruce Street, with laning returning to a two-lane facility.

A reconstructed signal with mast arm mounted signal indications is proposed for the Broadway intersection which may be funded under the 4-9's program; a similar new signal installation with pedestrian indications and a semi-actuated controller is proposed for the Pine Street intersection. Coordination units and an interconnect cable will be installed to provide for progression of the traffic between Main Street and Spruce Street. A street illumination system will be included with this project.

Broadway at Orange Street is shown striped for four lanes plus a left-turn lane, with parking prohibited. The laning arrangement shown here is suggestive only since Broadway and other CBD streets are currently under study in connection with a city funded CBD planning study to be completed in mid-1973.

Recommendations for the Orange Street and Alder Street sight visibility at the railroad undercrossing will be considered under the CBD Study (by others) and is therefore not to be included as a part of this TOPICS study.

LEGEND - SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Pedestrian
- Fatal
- Injury
- Parked Vehicle
- Fixed Object
- Overtaken
- Out of Control

ORANGE

LEGEND

- Time A=A.M P=P.M
- Pavement D=Dry W=Wet I-Icy
- Weather C=Clear F=Fog
- R=Rain SL=Sleet
- S=Snow

PROBABLE CAUSE

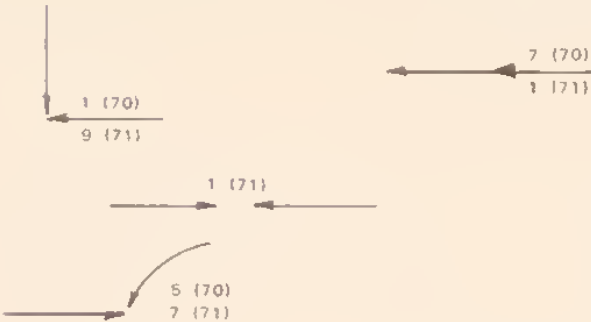
- Exceeding Safe speed (ESS)
- Exceeding Speed limit (ESL)
- Ran Stop sign (RSS)
- Ran Signal (RS)
- Stopped, then proceeded (S&P)
- Following too close (FTC)
- Wrong side of road (WSR)
- Violated right of way (V/RW)
- Had been drinking (HBD)
- Did not see traffic (NSTC)
- Control Device
- Driving attention diverted (DAD)
- Mechanical Failure (MF)

COLLISION DIAGRAM  
CITY OF MISSOULA  
1970 to 1971

BROADWAY  
AND ORANGE

LOCATION

BROADWAY



TOTAL = 31

ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |

COLLISION DIAGRAM  
CITY OF MISSOULA  
1970 to 1971

LEGEND - SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Pedestrian
- Fatal
- Injury
- Parked Vehicle
- Fixed Object
- Overturned
- Out of Control

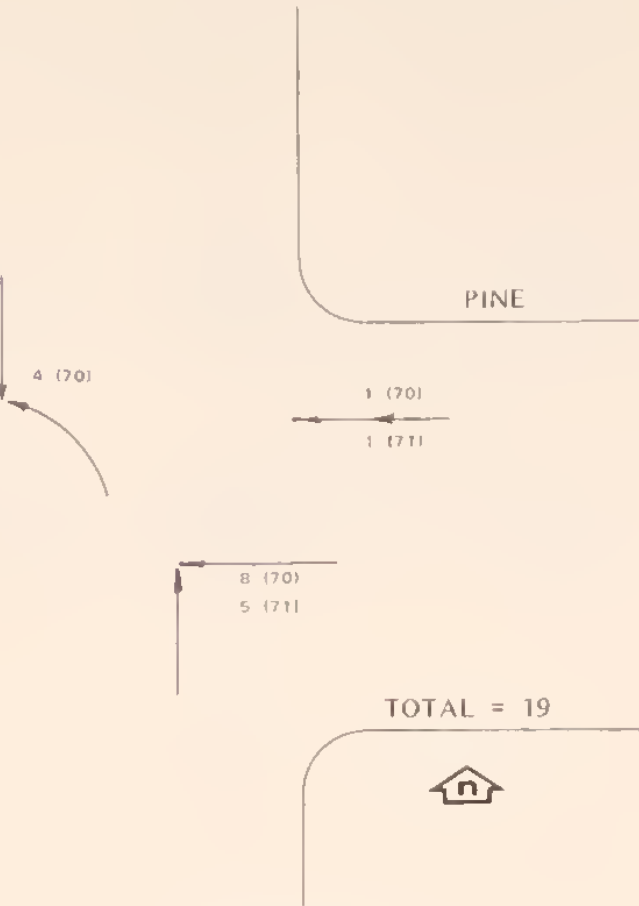
LEGEND

- Time A=A.M. P=P.M.
- Pavement D=Dry W=Wet I-Icy
- Weather C=Clear F=Fog
- R=Rain SL=Sleet
- S=Snow

PROBABLE CAUSE

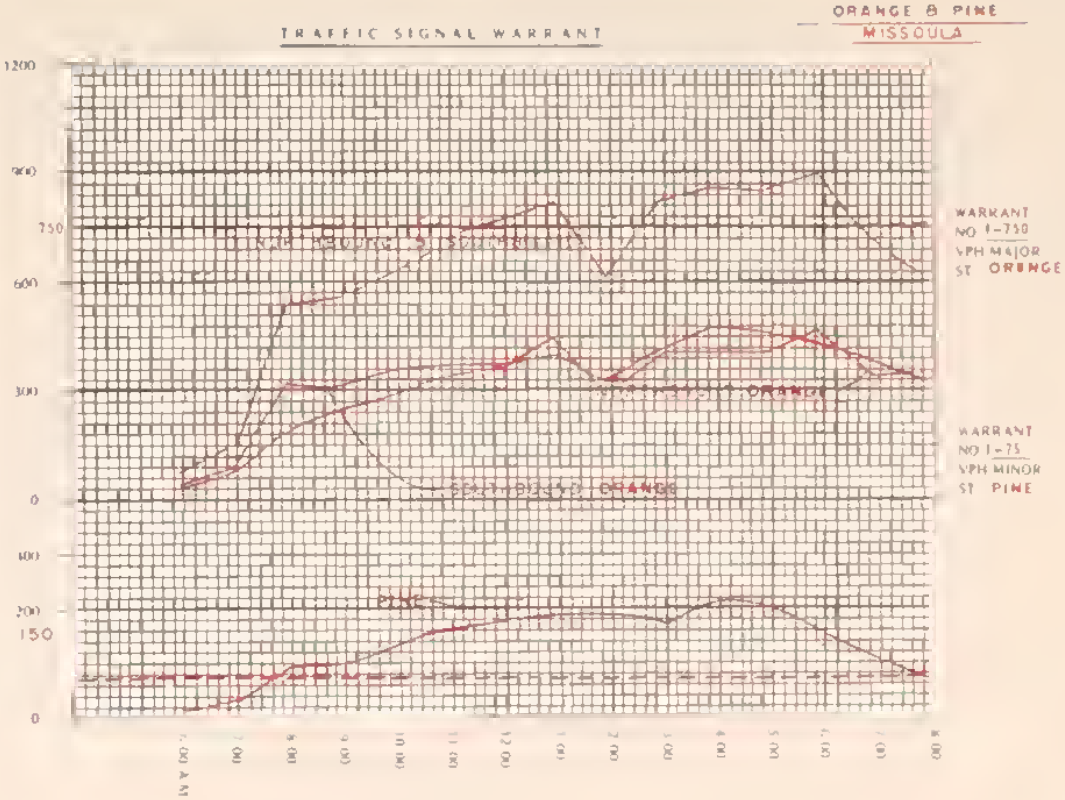
- Exceeding Safe speed (ESS)
- Exceeding Speed limit (ESL)
- Ran Stop sign (RSS)
- Ran Signal (RS)
- Stopped, then proceeded (S&P)
- Following too close (FTC)
- Wrong side of road (WSR)
- Violated right of way (V/RW)
- Had been drinking (HBD)
- Did not see traffic (NSTC)
- Control Device
- Driving attention diverted (DAD)
- Mechanical Failure (MF)

LOCATION ORANGE AND PINE



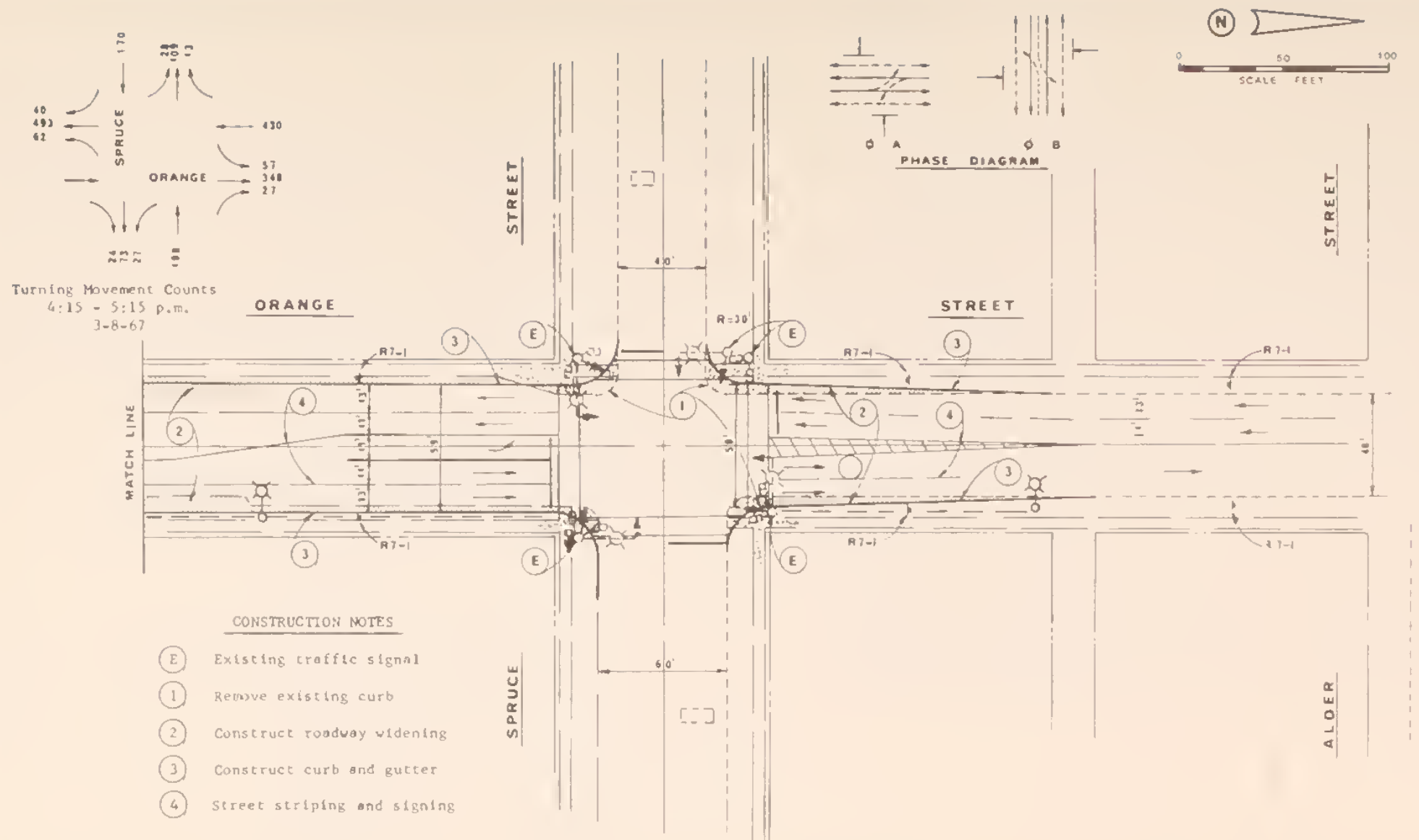
ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |









Street Improvements  
Orange St. at Spruce St.

ORANGE STREET FROM 160' SOUTH OF BROADWAY TO ALDER STREET

COST ESTIMATE

| <u>Description</u>                                                                                                         | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|----------------------------------------------------------------------------------------------------------------------------|-------------------------------|-------------|------------------|-------------------|
| 1. Street excavation                                                                                                       | 396                           | C.Y.        | \$ 3.00          | \$ 1,188.00       |
| 2. Roadway construction                                                                                                    | 1,187                         | S.Y.        | 6.00             | 7,122.00          |
| 3. Curb and gutter                                                                                                         | 1,925                         | L.F.        | 5.00             | 9,625.00          |
| 4. 2-Phase Type 2 semi-actuated<br>controller with cabinet complete<br>installed including interconnect<br>Orange and Pine | 1                             | Ea.         | 3,800.00         | 3,800.00          |
| 5. Traffic signal poles complete<br>with luminaire 20' Mast Arms<br>Orange and Pine                                        | 4                             | Ea.         | 2,200.00         | 8,800.00          |
| 6. Pedestrian heads Orange & Pine                                                                                          | 8                             | Ea.         | 190.00           | 1,520.00          |
| 7. Conduit and wire Orange & Pine                                                                                          | 320                           | L.F.        | 6.00             | 1,920.00          |
| 8. Inductive loops Orange & Pine                                                                                           | 4                             | Ea.         | 250.00           | 1,000.00          |
| 9. Conduit for street lighting and<br>interconnect                                                                         | 900                           | L.F.        | 4.00             | 3,600.00          |
| 10. Junction boxes                                                                                                         | 4                             | Ea.         | 65.00            | 260.00            |
| 11. Street signing and striping                                                                                            | 1                             | L.S.        | 600.00           | 600.00            |
| 12. Street lighting                                                                                                        | 4                             | Ea.         | 900.00           | 3,600.00          |
| Sub Total                                                                                                                  |                               |             |                  | \$43,035.00       |
| Contingencies, 10%                                                                                                         |                               |             |                  | 4,303.00          |
|                                                                                                                            |                               |             |                  | \$47,338.00       |
| Construction Engineering, 10%                                                                                              |                               |             |                  | 4,734.00          |
| GRAND TOTAL                                                                                                                |                               |             |                  | \$52,072.00       |

## TOPICS IMPROVEMENT PROJECT

Orange Street: North 2nd Street to North 3rd Street

### INTRODUCTION

The combination of Orange Street with 2nd Street and Frontage Road is the only route serving the industrial and residential area lying to the west of Orange Street and to the north of the railroad tracks. From the Burlington Northern Railroad underpass to the south ramps of Interstate 90, Orange Street is a 30-foot wide two-lane street carrying an AADT of 9,500.

North 2nd Street and North 3rd Street are currently operating as an East-West one-way couplet for automobile traffic, and the Frontage Road, which is the truck route to the industrial area, is a two-way street. The total combined traffic volume for the three streets is approximately 6,000 AADT.

### JUSTIFICATION

Thirteen accidents occurred at the 2nd Street intersection in 1970-1971 ranking in 6th in the city on an accident rate basis. However, the major cause of the accidents appears to be created from the backup of vehicles from the left turn movement at North 3rd Street.

Fourteen accidents occurred at the North 3rd Street and Orange Street intersection in 1970-1971 which ranks third in terms of accident rate. A heavy left-turn movement from northbound Orange Street to the Frontage Road via North 3rd Street complicated by the large open intersection area with many conflict points creates both congested and hazardous operating conditions. In addition, considerable truck traffic to and from the Frontage Road and the proximity of the freeway ramps add to the geometric problems at this location.

During the day time, sight distance is restricted from North 2nd Street to the south on Orange Street because of the lack of street illumination within the underpass and the vertical curve in relation to the underpass structure. Even though only two accidents seem to be directly attributable to the sight distance restriction, the lack of illumination in the underpass makes traffic movement from North 2nd Street hazardous when northbound Orange Street vehicles do not have their lights on. Therefore, an underpass illumination system is justified in order to reduce the potential hazard at North 2nd Street.

The proposed channelization and one-way operation of the Frontage Road should contribute to reduced traffic delays to Orange Street traffic and to reduced accidents at both intersections by removing a number of hazardous conflict points.

### SCOPE OF WORK

As shown on the Improvement Diagram, Orange Street is widened to provide a left-turn lane into North 3rd Street. The widening is all achieved on the west side of Orange Street in order to preserve trees along the east side of the street. A large channelizing island replaces the existing island at North 3rd Street and the Frontage Road. The Frontage Road will be converted one-way westerly to Worden Street via 5th Street.

Two alternatives are available for the one-way couplet complement both of which will solve the accident and conflict problem: A) as shown on the exhibit, retain North 2nd Street eastbound and convert North 3rd Street to a two-way operation, or B) reverse the one-way flow on North 3rd Street and convert North 2nd Street to a local access two-way street. The island at North 3rd Street would then be modified as indicated with dotted lines on the Improvement Diagram.

All signing modifications for the selected one-way system and street illumination between the underpass and the freeway offramps will be included as part of the project.

A minor amount of right-of-way will be required at the North 3rd Street intersection.

An illumination system will be installed in the railroad underpass. However, the illumination system could be constructed as a separate project and is not dependent upon the proposed widening, and therefore, is separated in the cost estimate.

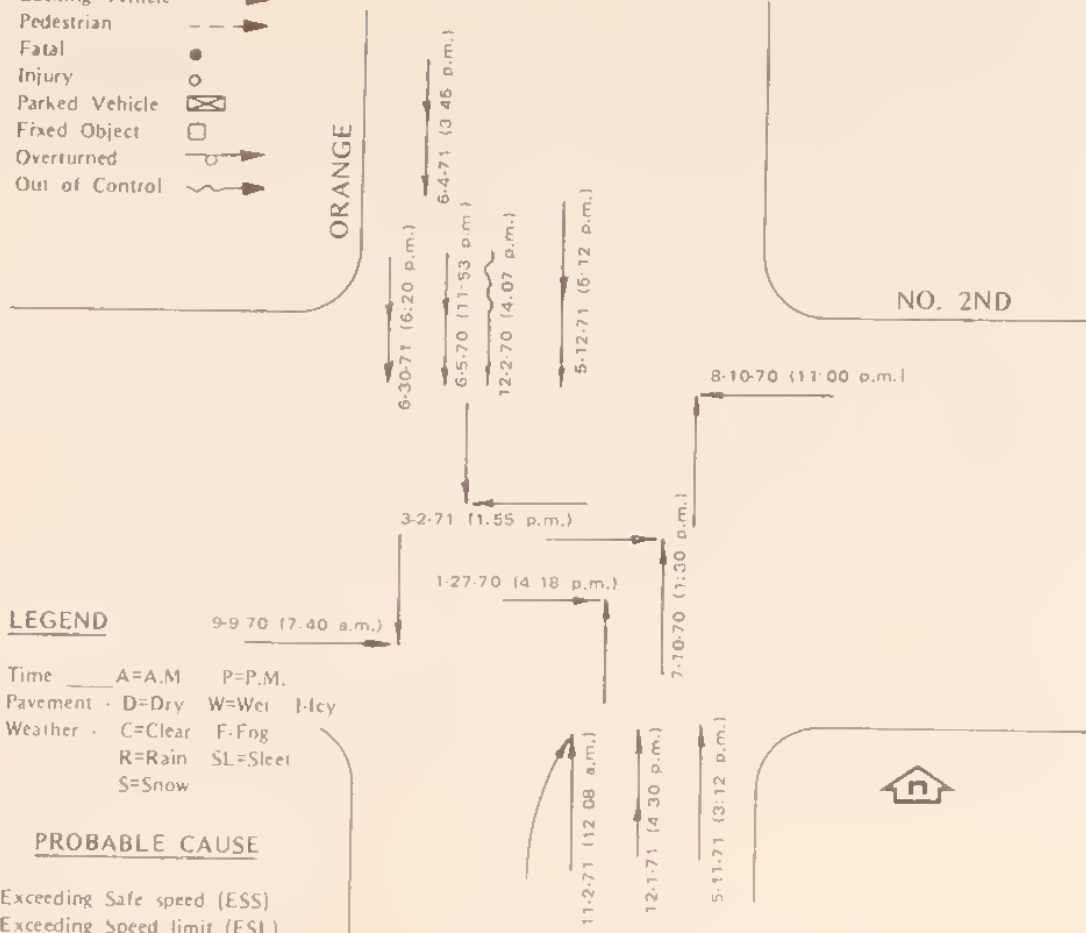
# COLLISION DIAGRAM

CITY OF MISSOULA  
1970 to 1971

## LEGEND - SYMBOLS

- Moving Vehicle →
- Backing Vehicle →
- Pedestrian →
- Fatal ●
- Injury ○
- Parked Vehicle ☒
- Fixed Object □
- Overtaken →
- Out of Control →

LOCATION ORANGE & NO. 2ND



## LEGEND

Time \_\_\_\_ A=A.M. P=P.M.  
 Pavement - D=Dry W=Wet I-Icy  
 Weather - C=Clear F-Fog  
 R=Rain SL=Sleet  
 S=Snow

## PROBABLE CAUSE

Exceeding Safe speed (ESS)  
 Exceeding Speed limit (ESL)  
 Ran Stop sign (RSS)  
 Ran Signal (RS)  
 Stopped, then proceeded (S&P)  
 Following too close (FTC)  
 Wrong side of road (WSR)  
 Violated right of way (V/RW)  
 Had been drinking (HBD)  
 Did not see traffic (NSTC)  
 Control Device  
 Driving attention diverted (DAD)  
 Mechanical Failure (MF)

## ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |

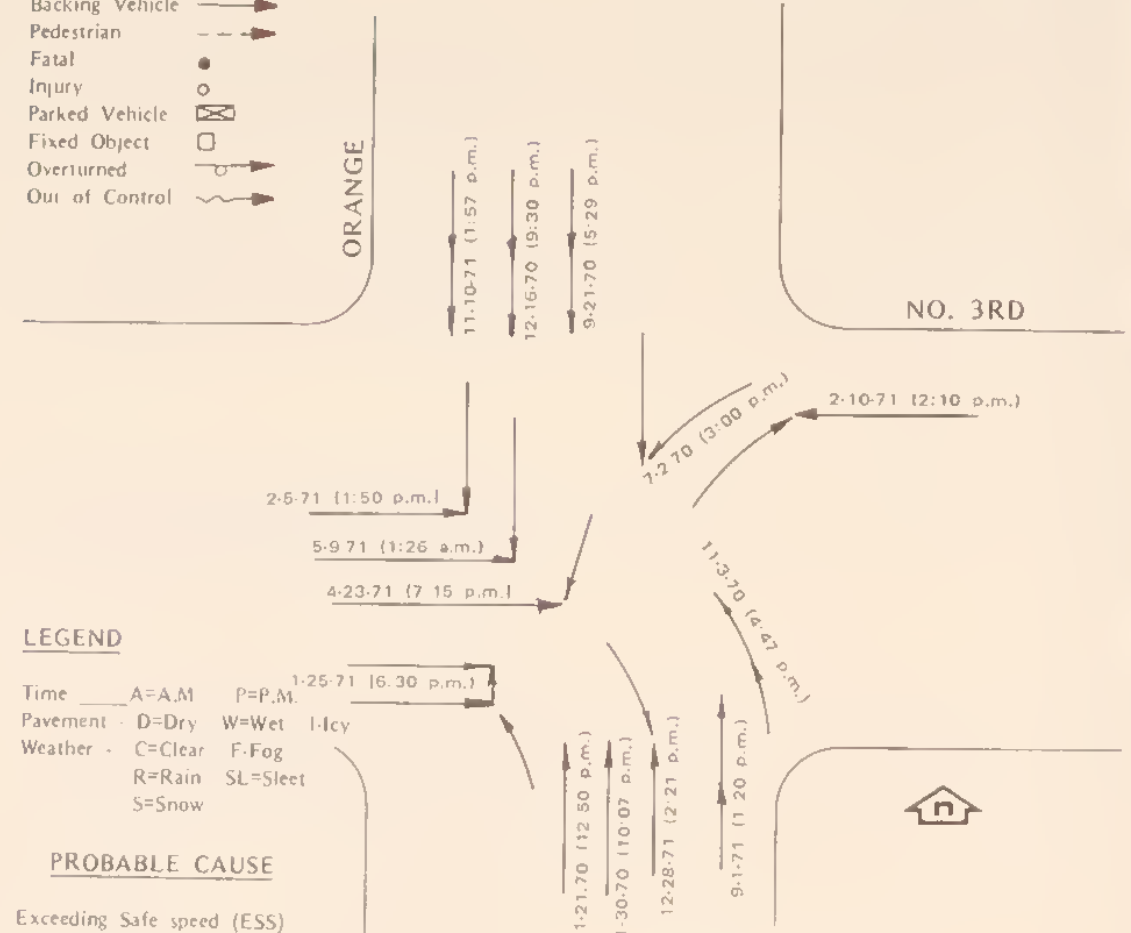
# COLLISION DIAGRAM

CITY OF MISSOULA  
1970 to 1971

## LEGEND - SYMBOLS

- Moving Vehicle →
- Backing Vehicle →
- Pedestrian →
- Fatal ●
- Injury ○
- Parked Vehicle ☒
- Fixed Object □
- Overtaken →
- Out of Control →

LOCATION ORANGE & NO. 3RD



## LEGEND

Time \_\_\_\_ A=A.M. P=P.M.  
 Pavement - D=Dry W=Wet I-Icy  
 Weather - C=Clear F-Fog  
 R=Rain SL=Sleet  
 S=Snow

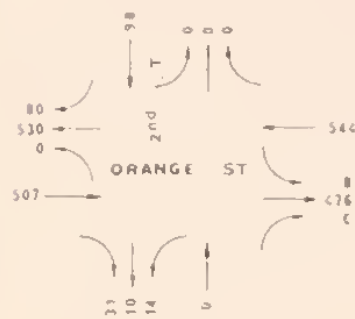
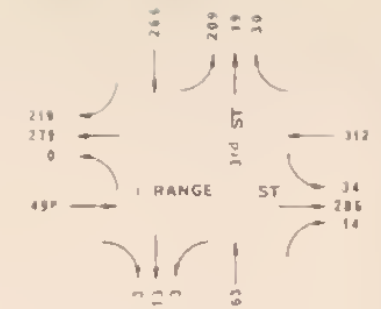
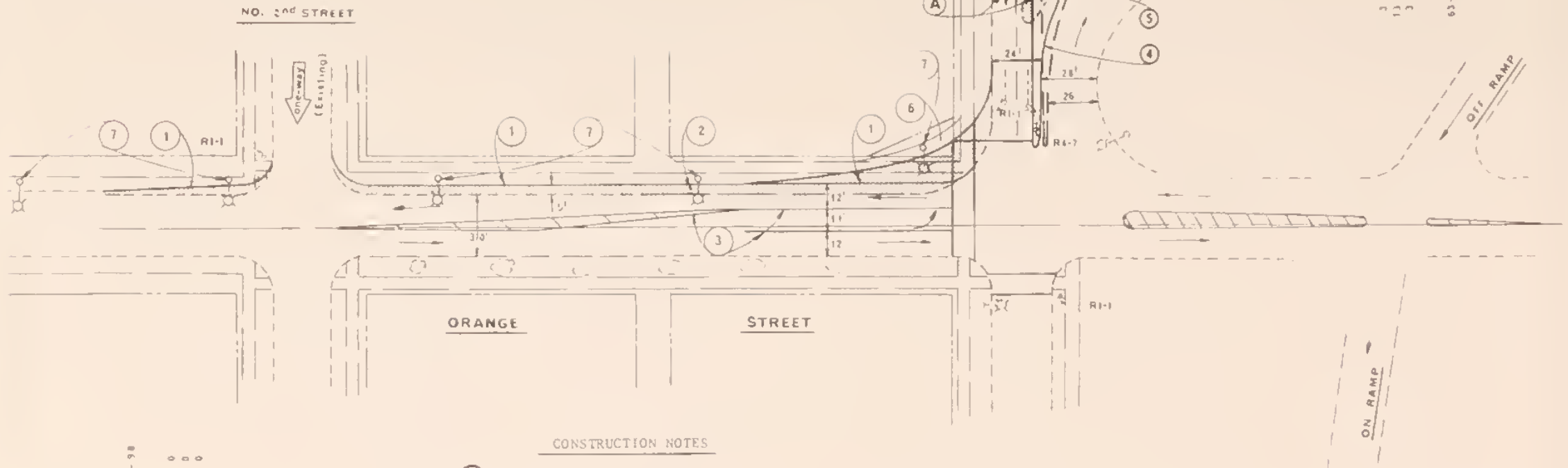
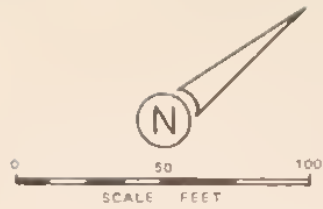
## PROBABLE CAUSE

Exceeding Safe speed (ESS)  
 Exceeding Speed limit (ESL)  
 Ran Stop sign (RSS)  
 Ran Signal (RS)  
 Stopped, then proceeded (S&P)  
 Following too close (FTC)  
 Wrong side of road (WSR)  
 Violated right of way (V/RW)  
 Had been drinking (HBD)  
 Did not see traffic (NSTC)  
 Control Device  
 Driving attention diverted (DAD)  
 Mechanical Failure (MF)

## ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |





Turning Movement Counts  
4:15 - 5:15 p.m.  
October 10, 1972

#### CONSTRUCTION NOTES

1. Construct new curb and gutter.
2. Construct new roadway.
3. Install street striping and signage
4. Construct type B curb
5. Median island
6. Construct sidewalk
7. Street lighting
- A. Alternate A
- B. Alternate B

Street Improvements  
Orange St. from No. 2nd St. to No. 3rd St.

ORANGE STREET AND NORTH 2ND STREET  
TO NORTH 3RD STREET

COST ESTIMATE

| <u>Description</u>                        | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|-------------------------------------------|-------------------------------|-------------|------------------|-------------------|
| 1. Street excavation                      | 54                            | C.Y.        | \$ 3.00          | \$ 162.00         |
| 2. Roadway construction                   | 160                           | S.Y.        | 6.00             | 960.00            |
| 3. Construct curb and gutter              | 320                           | L.F.        | 7.50             | 2,400.00          |
| 4. Street signing                         | 1                             | L.S.        | 750.00           | 750.00            |
| 5. Street lighting including<br>circuitry | 6                             | Ea.         | 1,300.00         | <u>7,800.00</u>   |
|                                           | Sub Total                     |             |                  | \$12,072.00       |
|                                           | Contingencies, 10%            |             |                  | 1,207.00          |
|                                           |                               |             |                  | \$13,279.00       |
|                                           | Construction Engineering, 10% |             |                  | <u>1,328.00</u>   |
|                                           | Total                         |             |                  | \$14,607.00       |
| 1. Railroad underpass lighting            | 1                             | L.S.        | 2,000.00         | <u>12,000.00</u>  |
|                                           | Sub Total                     |             |                  | \$12,000.00       |
|                                           | Contingencies, 10%            |             |                  | 1,200.00          |
|                                           |                               |             |                  | \$13,200.00       |
|                                           | Construction Engineering, 10% |             |                  | <u>1,320.00</u>   |
|                                           | Total                         |             |                  | \$14,520.00       |
|                                           | Orange Street                 |             |                  | <u>14,607.00</u>  |
|                                           | TOTAL - BOTH PROJECTS         |             |                  | \$29,127.00       |

## TOPICS IMPROVEMENT PROJECT

Brooks Street, Russell Street, Stephens Street  
Commercial Area

### INTRODUCTION AND SYSTEM JUSTIFICATION

Brooks Street between Russell Street and Mount Avenue is a four-lane facility with a 44-foot pavement width within a 60-foot right-of-way. Bisecting a grid street system diagonally, Brooks Street creates a number of closely spaced skewed intersections, some with five or six legs. Combined with a general lack of curbs, uncontrolled access to abutting property and minor cross streets and an AADT of approximately 18,000 with heavy truck traffic, the high accident rate and overall low level of traffic service on Brooks Street is quite severe as compared to the rest of the city street system.

Traffic is uniformly heavy throughout most of the daytime hours. As shown on the vehicular flow diagram, two-way traffic volume from approximately noon to 7 P.M. exceeds 90 percent of the P.M. peak hour volume.

The land use in the half-mile square area formed by Russell Street, South Avenue, Bancroft Street, the Mount Avenue and bisected diagonally by Brooks Street is largely a commercial area with a minor amount of residential development. A significant amount of vacant land and a planned major postal facility within this area indicate that traffic generated within this area will steadily increase.

The section of Brooks Street from Russell Street on the south to Mount Avenue on the north is perhaps the most hazardous segment of arterial street in the city. The two major intersections at Russell Street/South Avenue and Stephens Street rank among the most congested locations in the city. Carrying U.S. 93 and U.S. 12 traffic, this three-quarter mile long segment recorded 122 intersection accidents for the two-year period 1970-1971, which amounts to over 20 percent of the total accidents for all locations having six or more accidents. While records are not available for mid-block accidents, it appears that there was a substantial number of these accidents along this arterial segment. See Intersection Accident Spot Map.

Even with mid-block accidents excluded, Brooks Street has an accident rate over twice the national average for non-access-controlled urban arterials: approximately 12 accidents per million vehicle-miles versus 5.5 nationally.

Existing conditions along Brooks Street as described above support the urgent need for

control of access along the subject segment of this facility. In addition most of the local street intersections within the half-mile square corridor study area recorded three or more accidents during the 1970-1971 period, and accident experience can be expected to increase at these minor intersections with increased development in the area. Parking and loading operations create undesirable traffic friction and hazard at a number of locations.

### METHODOLOGY

During the initial phases of this TOPICS Study, several problem locations were isolated on the basis of the inventory data and were subjected to further analysis. It became readily apparent that it is impossible to fully solve one location without affecting or creating other problems at other locations. Consequently, the entire area bounded by Mount Avenue, Bancroft Street, South Avenue, and Russell Street were examined as an inter-related unit to determine the total circulation problem on the tentative Type II Streets and also to select or to justify other Type II Streets.

Additional data was collected and analyzed. Estimates were made of existing and future area traffic generation and converted into turning movements desired to and from Brooks Street. These estimates constituted an important input with regard to the proposed access pattern along Brooks Street.

Access alternatives and signal location alternatives were tested against the through traffic carrying capability of Brooks Street by examining progression optimization and by conducting capacity analyses.

Within the context of the TOPICS program, the proposed improvements were designed as much as possible within the existing right-of-way. The proposed improvements suggested for this area contained in the *Urban Transportation Plan* were analyzed; the majority of the suggested improvements in that Plan require large amounts of right-of-way. Nevertheless, the suggested improvements contained herein are coordinated with the long range goals and plans.

### PROPOSED DESIGN FEATURES AND CONTROLS FOR BROOKS STREET

The proposed cross section design utilized in connection with improvements at most of the locations along the subject segment of Brooks Street as discussed herein is as follows:

Through lane roadway (minimum): 12-foot shoulder lane and 11-foot median lane, with median and roadside curbs;



Vehicular Flow For Hour Ending at:

BROOKS STREET  
VEHICULAR FLOW NORTHBOUND AND  
SOUTHBOUND AT SOUTH AVENUE

Median: Basic 12-foot median, with 10-foot left-turn lane and 2-foot divider at left-turn locations. Median is narrowed to 4-6 feet at several points between Stephens Street and Mount Avenue.

Turning movements at signalized intersections were designed for the WB-50 Design Vehicle (large semi-trailer truck), while minor intersections were designed for SU-30, although efforts were made to accommodate semi-trailer trucks where practical.

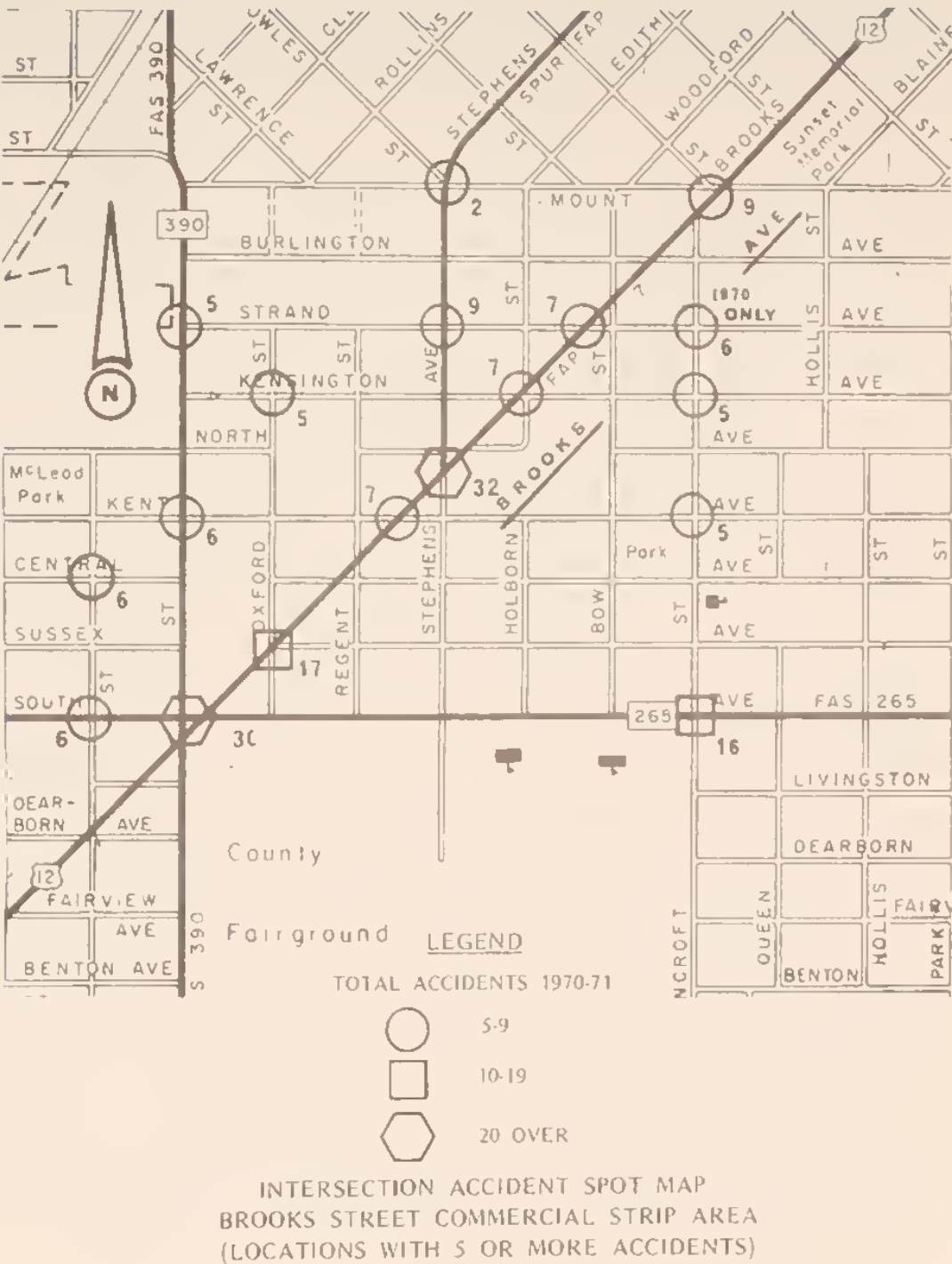
West of Stephens Avenue the total overall roadway width is 58 feet curb-to-curb. Since existing right-of-way is only 60 feet, acquisition of right-of-way or easements on both sides of the street for location of traffic control devices and walkways is necessary. This is also the case for one or both sides of the street between Stephens and Burlington Avenues. With parking areas constituting most of the property immediately behind the right-of-way line and very light pedestrian traffic along Brooks Street, the need for easements or additional right-of-way is of primary importance to providing space for the placement of traffic signal posts and signing. Parking is to be prohibited on the subject segment of Brooks Street.

In addition, the city, in cooperation with the commercial establishments, should develop an internal circulation plan (a project outside the scope of work of this report) to include redesign and reorientation of parking facilities, major driveway access points, and street vacation where appropriate.

Considerable lengths of median and most of the right-turn islands offer excellent landscaping possibilities for aesthetic enhancement of what is basically an unattractive strip commercial area.

SUMMARY OF PROPOSED WORK

It is recommended that left-turn lane islands proposed for a number of major locations along Brooks Street be connected together with additional median island to form a continuous median island on Brooks Street with the exception of breaks at Oxford Street, Bancroft Street, the existing signalized intersection at Stephens Avenue, and at the proposed signalized intersections at Central Avenue, at Strand Avenue, and at Washburn Street. The proposed median configuration coupled with other improvements at the above locations makes it desirable to channelize the intersections of the following local streets with Brooks Street to reinforce the safety of the right-turn-only movements: Sussex Avenue, Kent Avenue, Kensington Avenue, and Burlington Avenue (south leg only). Minor right-of-way acquisition will be required on the corner of the acute angle turn at these locations. The land involved is either vacant or a parking lot. In addition, it is recommended that channelization be provided on the north leg of Kensington Street to permit only a right-turn





exit movement from the southbound Brooks Street roadway, coupled with designation of Kensington Street as one-way westerly between Strand and Stephens Avenues. Further, it is proposed that Burlington Avenue be made one-way eastbound between Brooks and Bancroft Streets, and that the following streets be closed at Brooks Street: Livingston Avenue; Oxford Street (south leg); Regent Street; Holborn Street (south leg); and Bow Street (north leg). Along the three-quarter mile between Washburn Street and Mount Avenue left-turns *from* northbound Brooks Street would be permitted only at Washburn Street, Oxford Street, Stephens Avenue, Strand Avenue and Mount Avenue. Left-turns *from* southbound Brooks Street would be available at Bancroft Street, Stephens Avenue, Central Avenue, and Washburn Street. Left-turns *to* Brooks Street would be possible only at the existing signal at Stephens Avenue and the proposed signals at Washburn Street, at Central Avenue, at Strand Avenue and at Mount Avenue.

In order to totally implement the circulation plan proposed for Brooks Street, the following work shall also be constructed:

Widen and channelize South Avenue from Oxford Street to Washburn Street.

Widen and channelize Russell Street from Sussex Avenue to Dearborn Avenue.

Widen and channelize Dearborn Avenue from Russell Street to Brooks Street.

Widen and channelize Washburn Street from South Avenue to Brooks Street.

Channelization at Kent Avenue and Russell Street.

Channelization at Strand Avenue and Russell Street.

Install a traffic signal at Stephens Avenue and Strand Avenue.

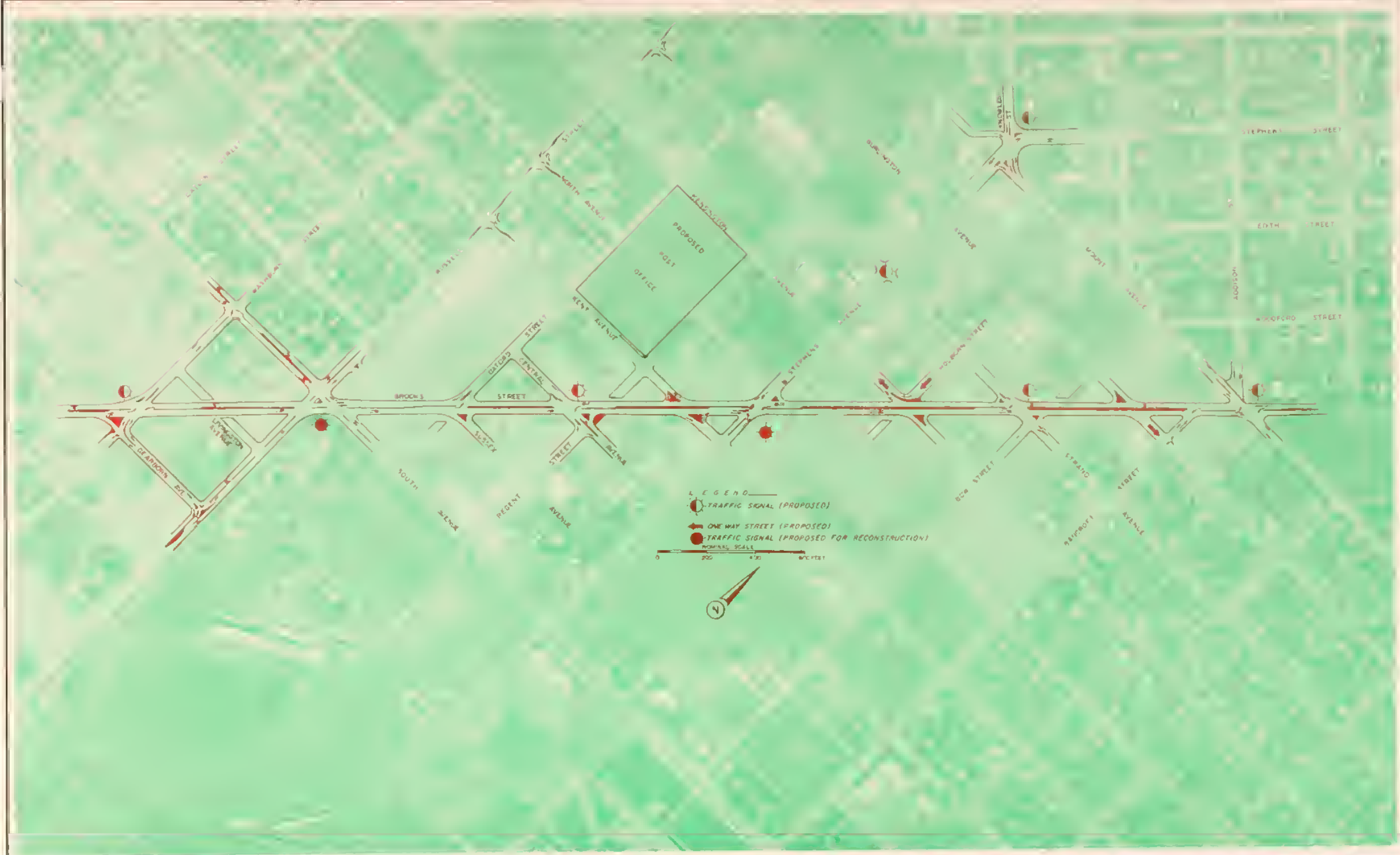
Install a traffic signal and channelization at Stephens Avenue, Mount Avenue, and Knowles Street.

Install 400 watt sodium vapor street illumination system within the project limits on Brooks Street, Russell Street, Dearborn Avenue, Washburn Street, and South Avenue.

Install destination signing in vicinity of Brooks Street, South Avenue and Russell Street intersection, and Brooks Street and Stephens Avenue intersection.

Install three dial coordinating units in all controllers at signalized intersections and interconnect cable and conduit throughout the length of the project.

The proposed improvements will facilitate the objective of the development of a strong, integrated circulation for secondary or collector traffic movements within the corridor area, guiding traffic to and from streets which are able to safely and efficiently accommodate traffic moving between the major arterial streets and the business establishments within the area, and promoting the use of South Avenue, Bancroft Street, Strand Avenue, and Stephens Avenue for providing area access. Channelization of traffic onto these streets will reduce the hazard and delay now occurring at many local street intersections by molding the existing diffuse local street movement pattern into a well defined and efficient pattern providing increased capital efficiency in connection with future improvements to these streets. The proposed restrictions to access through channelization and street closures should create little or no hardship for abutting and other nearby establishments since convenient alternative routes are provided. Indeed the denied left-turns from minor streets and driveways into Brooks Street will be safely and efficiently serviced by the new system of conveniently spaced traffic signals along Brooks Street.



Brooks St., Street Improvements & Traffic Signals

FUNDING AND COST ESTIMATE

Since this entire project, which is a TOPICS project by virtue of connecting individual projects on Brooks Street into one project, appears to be outside the funding capability of the allocated funds to the State of Montana, the following sections detail the proposed improvements for individual locations which might logically be constructed on a spot improvement basis by themselves when additional TOPICS funds are available. It also appears that additional funds from other sources might be applied to the project in cooperation between the city and the State. Since the adjacent area property owners will benefit from this improvement, a SID could be formed to defray part of the construction cost; right-of-way could be deeded to the city as partial payment of the SID costs. Since the "93 Strip" carries State-oriented and interstate traffic, perhaps FAP and other State gas tax funds could be applied to the project; the use of such funds, of course, would be dependent upon the State priority construction programs and would have to be evaluated against other State projects.

A summary of the cost estimate by project location is as follows:

|                                                                 |               |
|-----------------------------------------------------------------|---------------|
| Brooks Street: Russell Street, and South Avenue                 | \$248,000.00* |
| Brooks Street: Oxford Street and Sussex Avenue                  | 32,000.00     |
| Brooks Street: Central Avenue, Regent Street and Kent Avenue    | 65,000.00     |
| Brooks Street at Stephens Avenue                                | 59,000.00     |
| Brooks Street: Kensington Avenue and Holborn Street             | 33,000.00     |
| Brooks Street: Strand Avenue, Bow Street, and Burlington Avenue | 57,000.00     |
| Brooks Street: Mount Avenue and Bancroft Street                 | 52,000.00     |
| Stephens Avenue at Strand Avenue                                | 32,000.00     |

\*Includes Brooks @ Washburn, South @ Washburn, Russell @ Dearborn, and signing costs.

|                                                  |              |
|--------------------------------------------------|--------------|
| Stephens Avenue: Mount Avenue and Knowles Street | 48,000.00    |
| Russell Street at Kent Avenue                    | 2,000.00     |
| Russell Street at Strand Avenue                  | 2,000.00     |
| TOTAL                                            | \$630,000.00 |

Brooks Street: Russell Street and South Avenue

INTRODUCTION

The intersection of Brooks Street, Russell Street, and South Avenue is the primary focus of the so-called "93 Strip" and is the primary intersection for the entire southwest area of the city. Russell Street is the western-most cross-town north-south arterial which crosses the barriers posed by the rail lines and the Clark Fork River. South Avenue is an important east-west arterial. AADT leg volumes of 7,000 on South Avenue and 11,000 on Russell Street coupled with AADT's of 18,500 on the north leg and 15,000 on the south leg of Brooks Street, a poorly defined and extended intersection area, numerous conflicting turning movements, and four-phase signal control results in heavy congestion throughout much of the day. With uniformly heavy traffic flow on all three streets throughout most of the daytime hours, a wait of two signal cycles before proceeding through the intersection is usual. The preponderance of turning traffic collisions mirrors these traffic and roadway conditions, and the two-year total of 30 accidents rank this intersection as the fourth highest accident location in the city. An additional problem is blockage of northbound Russell Street traffic due to truck loading at the back of the shopping center between South and Kent Streets.

SCOPE OF WORK

All legs of the intersection are widened within the right-of-way to provide two approach and two exit lanes, with a third approach lane for a right-turn-only movement on the north approach of Brooks Street. Median islands and curbing are recommended on all legs. Three-phase traffic-actuated control replaces the existing four-phase actuated control and all direct left-turn movements are prohibited. New mast arm supported signal installations are proposed, some of which will carry optically programmed signal heads for more positive approach control. Turn prohibition and lane control signs will be mounted on the mast arms.

Left turns will be handled by indirect movements via Washburn Street and Dearborn Avenue which will require multi-phase signal control and channelization improvements at the intersection of Brooks Street with Washburn Street and Dearborn Avenue. Left-turns are prohibited from the north approach of Washburn Street, and a right-turn-only movement shown for Washburn Street at its secondary intersection with Dearborn Avenue. Right-of-way acquisition of vacant land is required in the northwest and southeast quadrants of the intersection.

The left-turn movement system will also require widening and channelization improvements at the intersection of South Avenue and Washburn Street, and at the intersection of Russell and Dearborn Streets. The channelization layout at the latter will provide for minimal delay for traffic turning left from Dearborn Avenue onto Russell Street, and can provide efficient signalization if future traffic growth warrants signal control. Minimal right-of-way acquisition is desirable at both intersections. Improvement Diagrams for all above suggested improvements are included with this project report. See Proposed Left-Turn Routes Diagram for proposed left-turn routes and off peak hourly volumes.

A high-type system of directional signing is essential, particularly with regard to guidance of the left-turn movements which are prohibited at the main intersection. A suggested preliminary directional signing layout is included with this report.

Consideration should be given to restrict truck loading hours along the east side of Russell Street, and for possible development of channelized loading bays which could reduce impedance to Russell Street traffic.

JUSTIFICATION

Congested and hazardous operating conditions support the need for major improvements at the primary intersection of Brooks Street with Russell Street and South Avenue. Analyses indicate that the proposed improvement will reduce the present 0.70 volume-to-capacity ratio to 0.41. A detailed analysis of peak-hour traffic delay indicates that the proposed improvement can reduce total peak-hour delay from the current level of 110 vehicle-hours to less than 40 vehicle-hours, even with allowance for increased travel distances for the proposed indirect left-turn movement pattern. Conservatively, a savings in motor vehicle idling delay operating costs in excess of \$12,000 annually at current levels of traffic would be afforded by the proposed improvements. In contrast to existing conditions, the proposed improvements also provide a substantial margin of excess capacity to accommodate future traffic growth without serious deterioration in the quality of traffic service performance.

The signal at Brooks Street, South Avenue, and Russell Street obviously meets Warrant No. 1 and Warrant No. 2; consequently, a signal warrant sheet is not included as part

of this report. Based upon a reassignment of left turn traffic, the signal at Washburn Street and Brooks Street is justified under Warrant No. 2 for a minimum of 10 hours a day (refer to Brooks Street hourly traffic flow graph). Since the project is contingent upon major changes in traffic flows, some of which are not entirely predictable, a signal warrant sheet is not included.

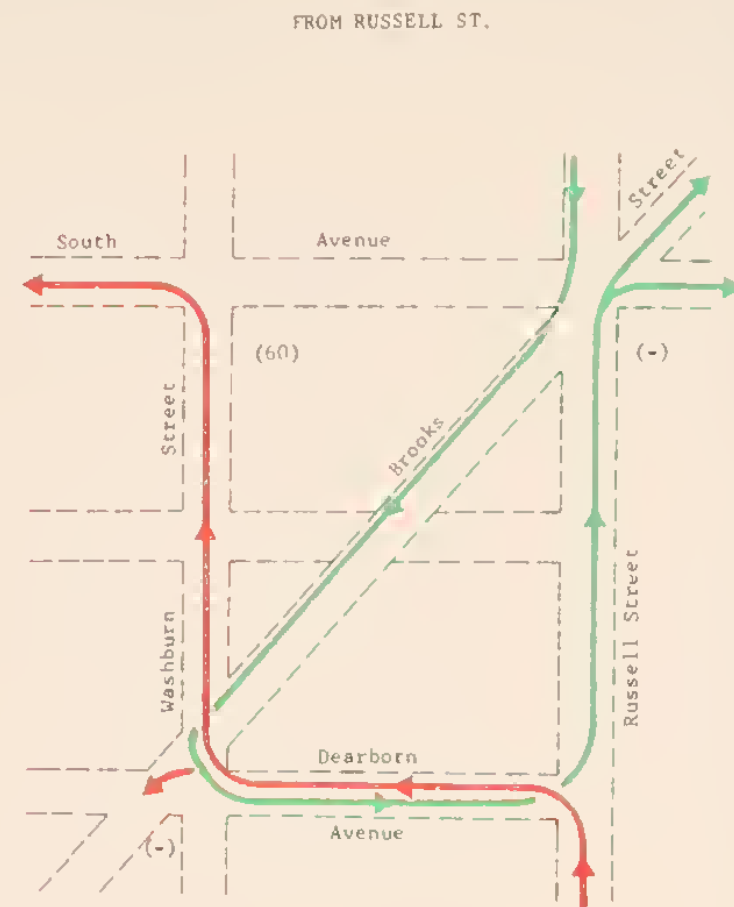
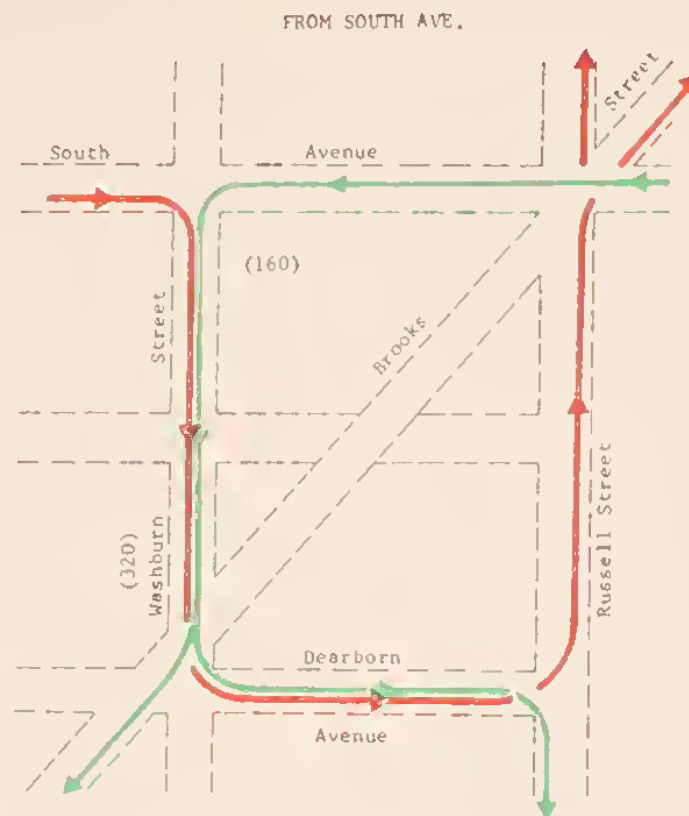
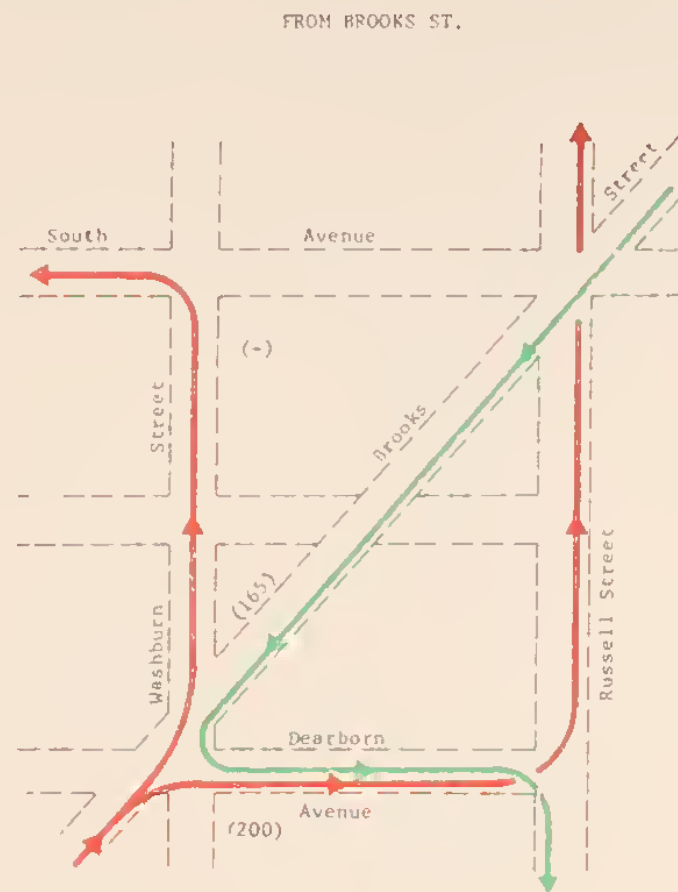
BROOKS - SOUTH - RUSSELL

LEFT TURN ROUTE SIGNING

COST ESTIMATE

| Description                    | Estimated Quantity            | Unit | Unit Cost | Total Cost   |
|--------------------------------|-------------------------------|------|-----------|--------------|
| 1. Signs                       | 518                           | S.F. | \$ 9.00   | \$ 4,662.00  |
| 2. Sign posts                  | 380                           | L.F. | 4.00      | 1,520.00     |
| 3. Cantilever                  | 1                             | Ea.  | 2,700.00  | 2,700.00     |
| 4. Overhead bridge for signing | 1                             | Ea.  | 12,000.00 | 12,000.00    |
|                                | Sub Total                     |      |           | \$ 20,882.00 |
|                                | Contingencies, 10%            |      |           | 2,088.00     |
|                                |                               |      |           | \$ 22,970.00 |
|                                | Construction Engineering, 10% |      |           | 2,297.00     |
|                                | GRAND TOTAL                   |      |           | \$ 25,267.00 |





LEGEND

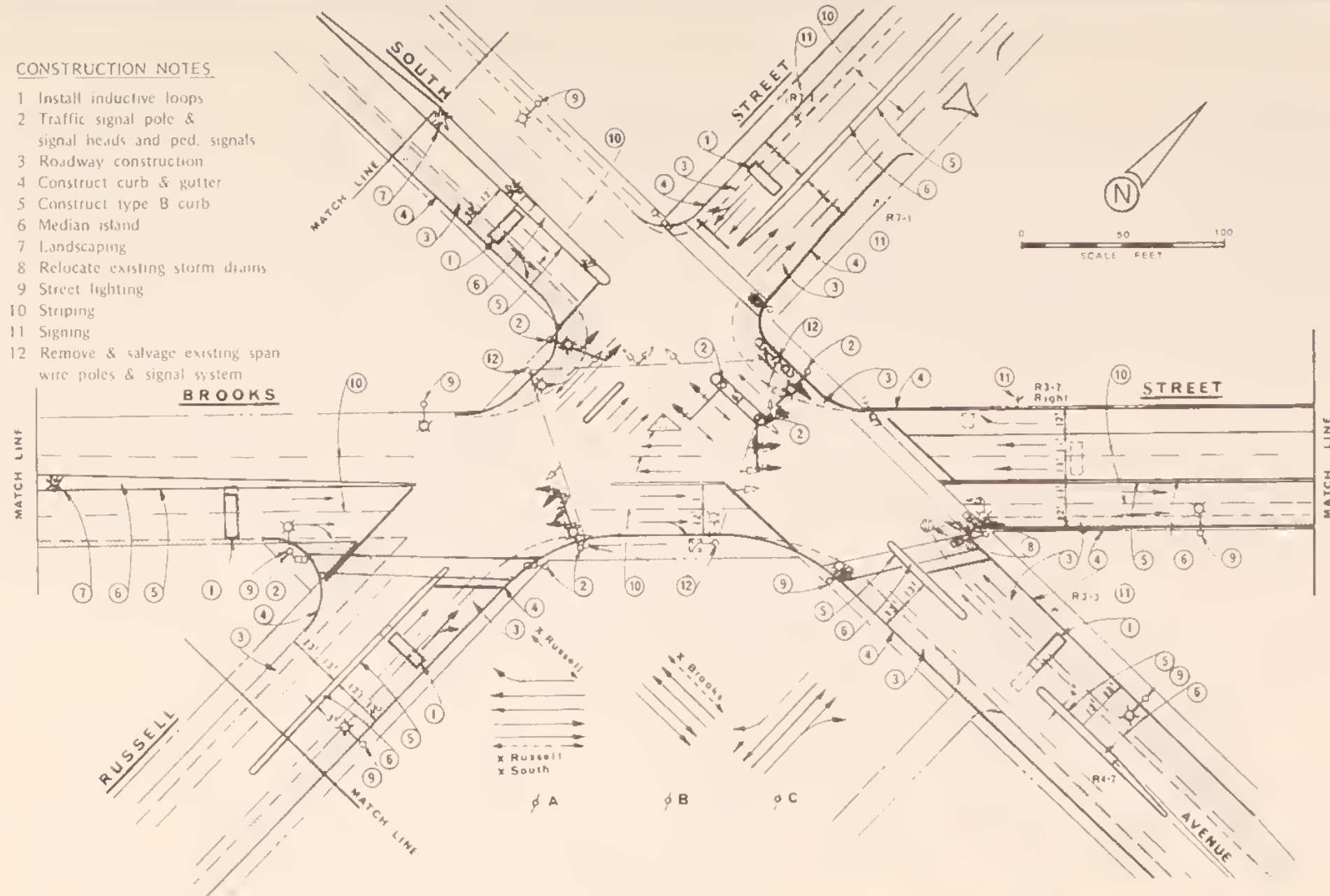
(XXX) ESTIMATED HOURLY VOLUMES - OFF PEAK

Proposed Left-Turn Routes  
Russell St., Brooks St. & South Ave.

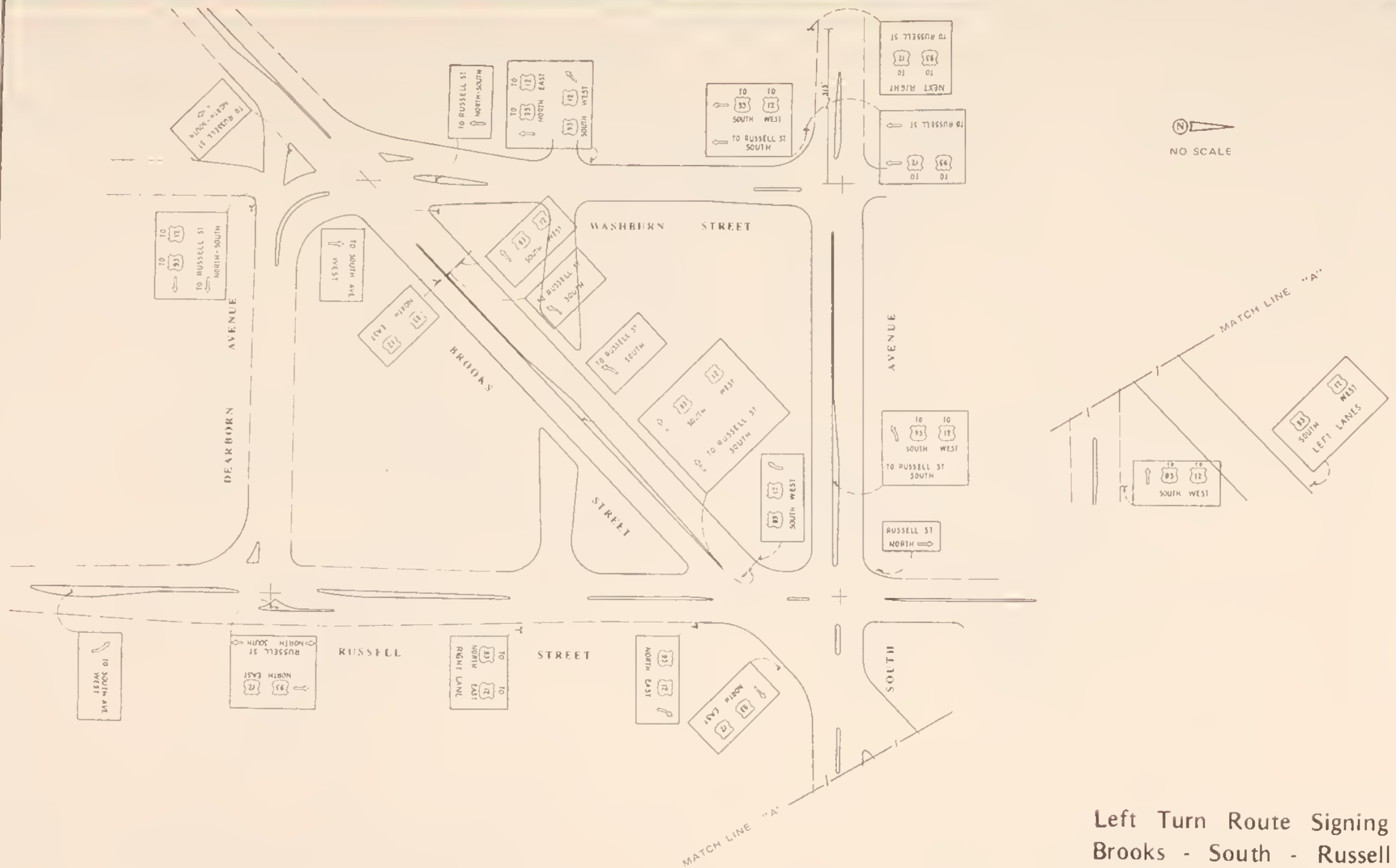


# CONSTRUCTION NOTES

- 1 Install inductive loops
- 2 Traffic signal pole & signal heads and ped. signals
- 3 Roadway construction
- 4 Construct curb & gutter
- 5 Construct type B curb
- 6 Median island
- 7 Landscaping
- 8 Relocate existing storm drains
- 9 Street lighting
- 10 Striping
- 11 Signing
- 12 Remove & salvage existing span wire poles & signal system



Traffic Signal Modification & Street Widening  
Brooks St. Russell St. & South Ave.



Left Turn Route Signing  
Brooks - South - Russell

BROOKS STREET - SOUTH AVENUE - RUSSELL STREET

COST ESTIMATE

| <u>Description</u>                                              | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|-----------------------------------------------------------------|-------------------------------|-------------|------------------|-------------------|
| 1. Inductive loops                                              | 5                             | Ea.         | \$ 250.00        | \$ 1,250.00       |
| 2. Traffic signal pole and signal heads                         |                               |             |                  |                   |
| 20' Mast Arm                                                    | 3                             | Ea.         | 2,200.00         | 6,600.00          |
| 25' Mast Arm                                                    | 2                             | Ea.         | 2,600.00         | 5,200.00          |
| street lights                                                   | 2                             | Ea.         | 1,008.00         | 2,016.00          |
| ped. head posts                                                 | 5                             | Ea.         | 350.00           | 1,750.00          |
| 3. Street excavation                                            | 435                           | C.Y.        | 3.00             | 1,305.00          |
| 4. Conduit and wiring                                           | 200                           | L.F.        | 6.00             | 1,200.00          |
| 5. Roadway construction                                         | 1,305                         | S.Y.        | 6.00             | 7,830.00          |
| 6. Concrete curb and gutter                                     | 1,610                         | L.F.        | 5.00             | 8,050.00          |
| 7. Concrete Type B curb                                         | 2,000                         | L.F.        | 3.00             | 6,000.00          |
| 8. Median island construction                                   | 2,840                         | L.F.        | 3.00             | 8,520.00          |
| 9. Landscaping                                                  | 3                             | Ea.         | 50.00            | 150.00            |
| 10. Relocate storm drain                                        | 1                             | Ea.         | 250.00           | 250.00            |
| 11. Street lighting                                             | 7                             | Ea.         | 900.00           | 6,300.00          |
| 12. Conduit and wiring                                          | 1,200                         | L.F.        | 4.00             | 4,800.00          |
| 13. Street striping                                             | 1                             | L.S.        | 600.00           | 600.00            |
| 14. Signing                                                     | 8                             | Ea.         | 50.00            | 400.00            |
| 15. Remove and salvage spanwire,<br>traffic signals and signing | 1                             | L.S.        | 1,000.00         | <u>1,000.00</u>   |
|                                                                 | Sub Total                     |             |                  | \$ 63,221.00      |
|                                                                 | Contingencies, 10%            |             |                  | 6,322.00          |
|                                                                 |                               |             |                  | \$ 69,543.00      |
|                                                                 | Construction Engineering, 10% |             |                  | <u>6,954.00</u>   |
|                                                                 | GRAND TOTAL                   |             |                  | \$ 76,494.00      |

1. Install 5 phase full-actuated controller complete with cabinet
2. Install traffic signal poles with signal heads
3. Install inductive loops
4. Roadway construction
5. Construct curb and gutter
6. Construct type B curb
7. Median island
8. Landscaping
9. Street lighting
10. Street striping
11. Street signing
12. Install guard rail

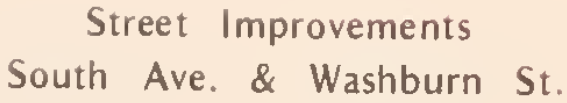


BROOKS STREET - WASHBURN STREET - DEARBORN STREET

COST ESTIMATE

| <u>Description</u>                                                                  | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u> | <u>Description</u>            | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|-------------------------------------------------------------------------------------|-------------------------------|-------------|------------------|-------------------|-------------------------------|-------------------------------|-------------|------------------|-------------------|
| 1. Install 5 phase fully-actuated controller complete with cabinet and interconnect | 1                             | L.S.        | \$11,500.00      | \$11,500.00       | 13. Median island             | 283                           | S.Y.        | 3.00             | 849.00            |
| 2. Traffic signal poles complete installed                                          |                               |             |                  |                   | 14. Landscaping               | 5                             | Ea.         | 50.00            | 250.00            |
| 25' Mast Arm                                                                        | 1                             | Ea.         | 2,500.00         | 2,500.00          | 15. Street striping           | 1                             | L.S.        | 500.00           | 500.00            |
| 30' Mast Arm                                                                        | 1                             | Ea.         | 3,200.00         | 3,200.00          | 16. Signing - regulatory      | 14                            | Ea.         | 50.00            | 700.00            |
| 35' Mast Arm                                                                        | 1                             | Ea.         | 3,500.00         | 3,500.00          |                               |                               |             |                  |                   |
| 3. Conduit and wiring                                                               |                               |             |                  |                   | Sub Total                     |                               |             |                  | \$72,420.00       |
| 2"                                                                                  | 300                           | L.F.        | 6.00             | 1,800.00          | Contingencies, 10%            |                               |             |                  | 7,242.00          |
| 1"                                                                                  | 200                           | L.F.        | 3.00             | 600.00            |                               |                               |             |                  |                   |
| 4. Junction box                                                                     | 7                             | Ea.         | 65.00            | 455.00            |                               |                               |             |                  | \$79,662.00       |
| 5. Inductive loop                                                                   | 16                            | Ea.         | 250.00           | 4,000.00          | Construction Engineering, 10% |                               |             |                  | 7,966.00          |
| 6. Service                                                                          | 1                             | Ea.         | 200.00           | 200.00            |                               |                               |             |                  |                   |
| 7. Street lighting                                                                  | 8                             | Ea.         | 900.00           | 7,200.00          | GRAND TOTAL                   |                               |             |                  | \$87,628.00       |
| 8. Conduit and wiring-Interconnect and street lighting                              | 1,400                         | L.F.        | 4.00             | 7,600.00          |                               |                               |             |                  |                   |
| 9. Street excavation                                                                | 710                           | C.Y.        | 3.00             | 2,130.00          |                               |                               |             |                  |                   |
| 10. Roadway construction                                                            | 2,131                         | S.Y.        | 6.00             | 12,786.00         |                               |                               |             |                  |                   |
| 11. Concrete curb and gutter                                                        | 1,600                         | L.F.        | 5.00             | 8,000.00          |                               |                               |             |                  |                   |
| 12. Type B curb                                                                     | 1,550                         | L.F.        | 3.00             | 4,650.00          |                               |                               |             |                  |                   |





SOUTH AVENUE AND WASHBURN STREET

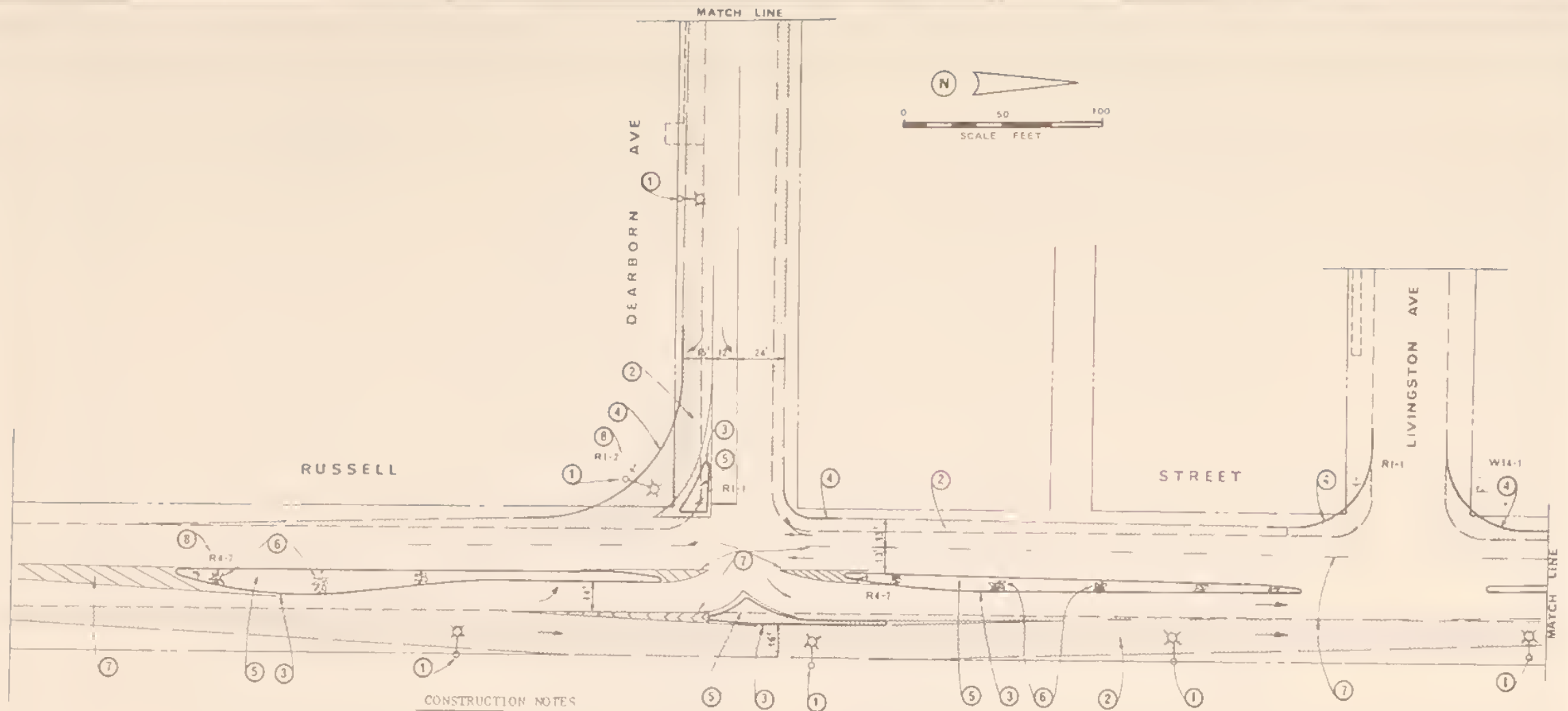
COST ESTIMATE

| <u>Description</u>               | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u>        |
|----------------------------------|-------------------------------|-------------|------------------|--------------------------|
| 1. Street excavation             | 192                           | C.Y.        | \$ 3.00          | \$ 576.00                |
| 2. Roadway construction          | 577                           | S.Y.        | 6.00             | 3,462.00                 |
| 3. Concrete curb and gutter      | 312                           | L.F.        | 5.00             | 1,560.00                 |
| 4. Type B curb                   | 840                           | L.F.        | 3.00             | 2,520.00                 |
| 5. Median island fill            | 140                           | S.Y.        | 3.00             | 420.00                   |
| 6. Landscaping                   | 5                             | Ea.         | 50.00            | 250.00                   |
| 7. Relocate existing storm drain | 1                             | Ea.         | 250.00           | 250.00                   |
| 8. Street striping               | 1                             | L.S.        | 200.00           | 200.00                   |
| 9. Conduit and wiring            | 720                           | L.F.        | 4.00             | 2,880.00                 |
| 10. Signing                      | 4                             | Ea.         | 50.00            | 200.00                   |
| 11. Street lighting              | 6                             | Ea.         | 900.00           | <u>5,400.00</u>          |
| Sub Total<br>Contingencies, 10%  |                               |             |                  | \$ 17,718.00<br>1,772.00 |
|                                  |                               |             |                  | \$ 19,490.00             |
| Construction Engineering, 10%    |                               |             |                  | <u>1,949.00</u>          |
| GRAND TOTAL                      |                               |             |                  | \$ 21,439.00             |

RUSSELL STREET AND DEARBORN AVENUE

COST ESTIMATE

| <u>Description</u>              | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u>        |
|---------------------------------|-------------------------------|-------------|------------------|--------------------------|
| 1. Street lighting              | 6                             | Ea.         | \$ 900.00        | \$ 5,400.00              |
| 2. Conduit and wiring           | 760                           | L.F.        | 4.00             | 3,040.00                 |
| 3. Street excavation            | 741                           | C.Y.        | 3.00             | 2,223.00                 |
| 4. Roadway construction         | 2,222                         | S.Y.        | 6.00             | 13,332.00                |
| 5. Concrete curb and gutter     | 350                           | L.F.        | 5.00             | 1,750.00                 |
| 6. Concrete Type B curb         | 1,200                         | L.F.        | 3.00             | 3,600.00                 |
| 7. Median island fill           | 357                           | S.Y.        | 3.00             | 1,071.00                 |
| 8. Landscaping                  | 8                             | Ea.         | 50.00            | 400.00                   |
| 9. Street striping              | 1                             | L.S.        | 350.00           | 350.00                   |
| 10. Signing                     | 3                             | Ea.         | 50.00            | <u>150.00</u>            |
| Sub Total<br>Contingencies, 10% |                               |             |                  | \$ 31,316.00<br>3,132.00 |
|                                 |                               |             |                  | \$ 34,448.00             |
| Construction Engineering, 10%   |                               |             |                  | <u>3,445.00</u>          |
| GRAND TOTAL                     |                               |             |                  | \$ 37,893.00             |



# CONSTRUCTION NOTES

- ① Street lighting
- ② Roadway construction
- ③ Construct type B curb
- ④ Construct curb and gutter
- ⑤ Median island
- ⑥ Landscaping
- ⑦ Street striping
- ⑧ Signin

Street Improvements  
Russell St. & Dearborn Ave.

## INTRODUCTION

The north leg of Oxford Street provides important access to and from the parking area for a shopping center located in the northeast quadrant of the Brooks/Russell Street intersection and will provide a convenient connection for traffic from the south on Brooks Street and the proposed major U.S. Postal facility to be located between Oxford and Regent Streets and Kent and Kensington Avenues. Current AADT on the north leg of Oxford Street is 3,000 while traffic on its south leg is minimal. The two-year accident total is 17 accidents, with 14 of them involving Oxford and/or Brooks Street, and three involving Sussex Street traffic.

## SCOPE OF WORK

Construct a protected left-turn lane from northbound Brooks Street to Oxford Street. The proposed signal control on Brooks Street at Central Avenue one block to the north will provide adequate gaps for the left-turn movement. The north leg of Oxford Street is channelized to reinforce a right-turn-only pattern to and from southbound Brooks Street, while a cul-de-sac treatment is recommended for the south leg of Oxford Street. Sussex Avenue is channelized to permit right-turn-only movement to and from northbound Brooks Street.

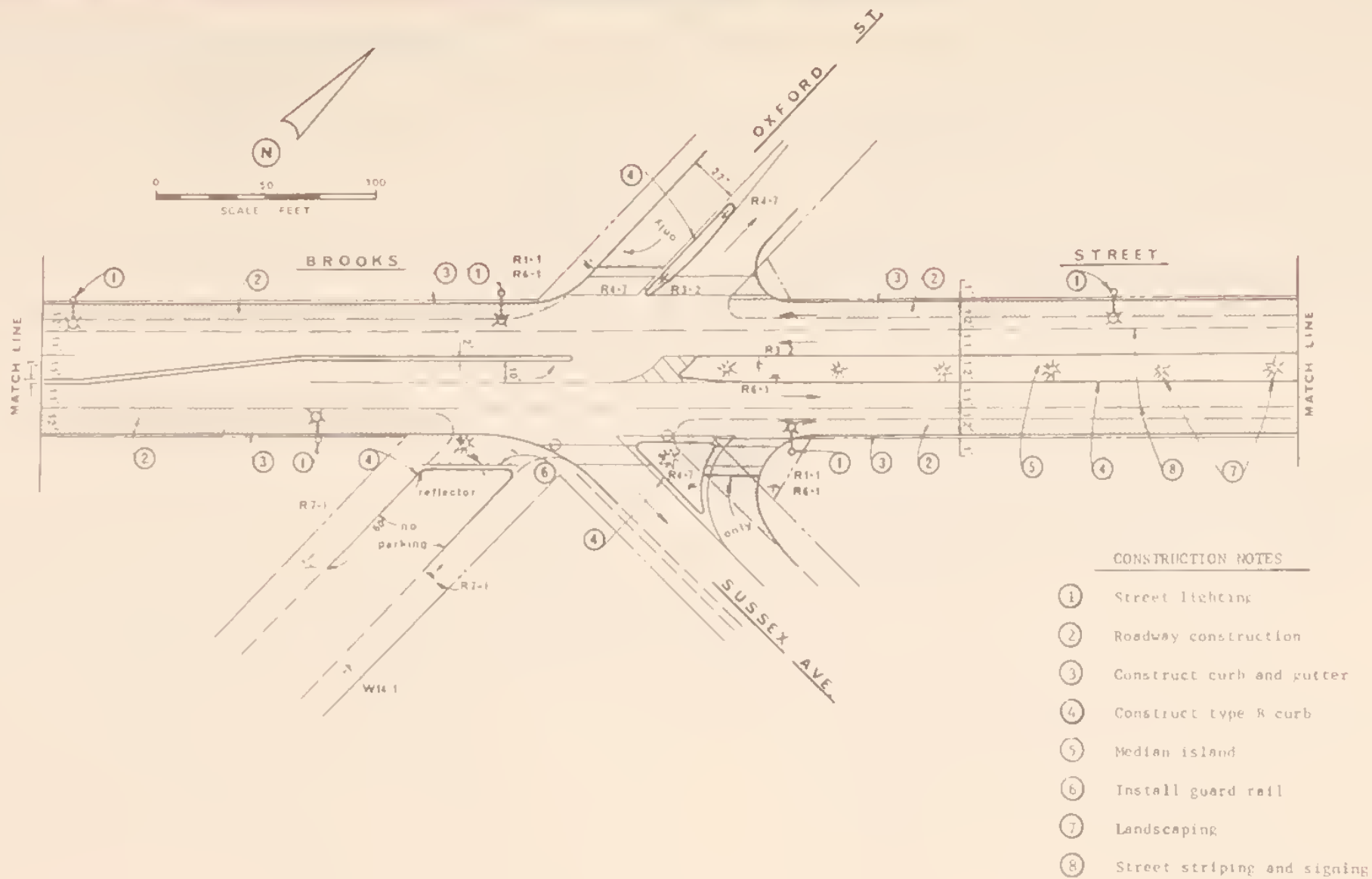
## JUSTIFICATION

The median channelization at this location is a short extension of median islands required at Russell Street/South Avenue to the south and at the proposed signal at Central Avenue to the north. The proposed treatment will provide necessary controlled access to the shopping center and the proposed post office for traffic from the south on Brooks Street, and will eliminate the two types of accidents which predominate at this location: right-angle collisions and collisions between through and left-turning vehicles on Oxford Street. No hardship to establishments adjacent to the south leg of Oxford Street is expected from closure of this street segment at Brooks Street.

## BROOKS AVENUE AND OXFORD STREET

## COST ESTIMATE

| <u>Description</u>                                   | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|------------------------------------------------------|-------------------------------|-------------|------------------|-------------------|
| 1. Street lighting                                   | 5                             | Ea.         | \$ 900.00        | \$ 4,500.00       |
| 2. Conduit and wiring - Interconnect street lighting | 1,120                         | L.F.        | 4.00             | 4,480.00          |
| 3. Street excavation                                 | 283                           | C.Y.        | 3.00             | 849.00            |
| 4. Roadway construction                              | 849                           | S.Y.        | 6.00             | 5,094.00          |
| 5. Concrete curb and gutter                          | 1,100                         | L.F.        | 5.00             | 5,500.00          |
| 6. Type B curb                                       | 1,255                         | L.F.        | 3.00             | 3,765.00          |
| 7. Median island fill                                | 389                           | S.Y.        | 3.00             | 1,167.00          |
| 8. Guard rail                                        | 40                            | L.F.        | 7.50             | 300.00            |
| 9. Landscaping                                       | 6                             | Ea.         | 50.00            | 300.00            |
| 10. Street striping and signing                      | 1                             | L.S.        | 800.00           | 800.00            |
| Sub Total                                            |                               |             |                  | \$26,755.00       |
| Contingencies, 10%                                   |                               |             |                  | 2,676.00          |
|                                                      |                               |             |                  | \$29,431.00       |
| Construction Engineering, 10%                        |                               |             |                  | 2,943.00          |
| GRAND TOTAL                                          |                               |             |                  | \$32,374.00       |



Street Improvements  
Brooks St. at Oxford St. & Sussex Ave.



INTRODUCTION

Central Avenue is presently a lightly traveled local street which provides a direct connection to the Russell Street shopping center for traffic from the north on Brooks Street. Traffic destined north on Brooks Street will also use Central Avenue to exit from a major entrance for the proposed post office between Oxford and Regent Streets.

SCOPE OF WORK

Two-phase semi-actuated signal control is proposed for this location together with widening of both legs of Central Avenue. A left-turn lane is provided for the movement from southbound Brooks Street to eastbound Central Avenue and to southbound Regent Street, which is the only southbound left turn allowed on Brooks Street between Stephens Avenue and Russell Street. The northbound Brooks Street left turn is prohibited since this movement is provided at Oxford Street to the south.

The lightly traveled south approach of Regent Street is to be restricted to a right-turn-only movement to Central Avenue in order to reduce the complexity of movements at this skewed multileg intersection, while the north leg of Regent Street is to be closed.

Kent Avenue is channelized on both legs to permit right-turn-only movements.

JUSTIFICATION

The proximity of the existing shopping center and the proposed post office together with the corridor trip generation analyses support the need for traffic signals at this location.

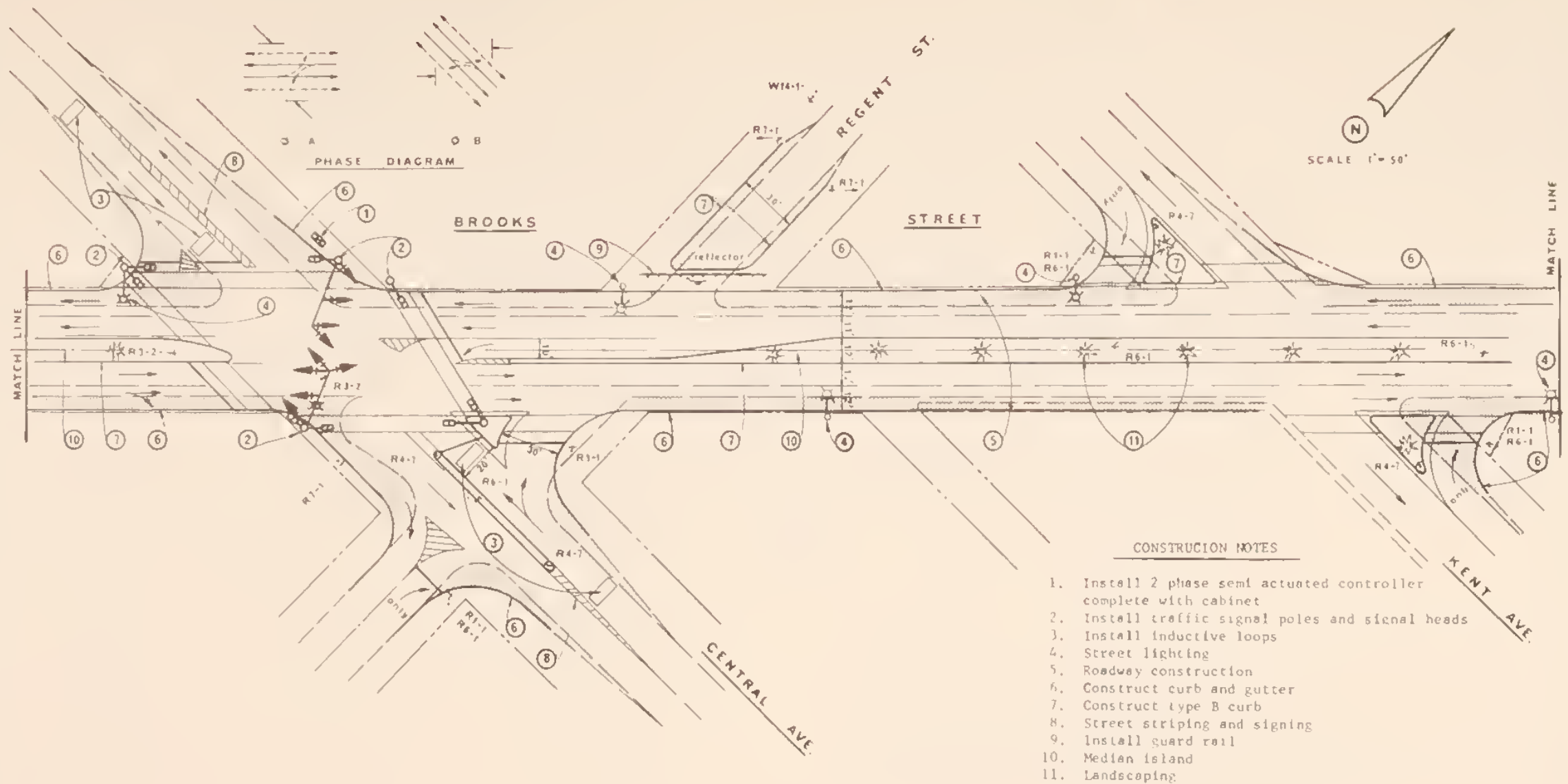
Since the proposed signal is contingent upon major changes in traffic flows emanating from all the proposed access changes, a signal warrant sheet is not included with this report. However, the signal is justified under the Progressive Movement Warrant in order to provide adequate gaps at Oxford Street and will most certainly be justified under Warrant No. 1 and Warrant No. 2 upon implementation of all access changes on this segment of Brooks Street.

Since only short sections of street are involved and convenient alternative routes are available, no hardship to establishments is expected on Regent Street owing to the cul-de-sac treatment on the north leg and prohibited turns on the south approach, which also holds true for the right-turn-only treatment at Kent Avenue. The safety and efficiency of intersection operations will be substantially improved by these restrictions.

BROOKS AVENUE AND CENTRAL STREET

COST ESTIMATE

| Description                                                    | Estimated Quantity | Unit | Unit Cost   | Total Cost  |
|----------------------------------------------------------------|--------------------|------|-------------|-------------|
| 1. Install 2-phase semi-actuated controller, complete in place | 1                  | Ea.  | \$ 3,500.00 | \$ 3,500.00 |
| 2. Traffic signal poles and signal heads                       | 2                  | Ea.  | 3,000.00    | 6,000.00    |
| 30' Mast Arms                                                  | 3                  | Ea.  | 500.00      | 1,500.00    |
| Post mount                                                     |                    |      |             |             |
| 3. Conduit and conductors                                      |                    |      |             |             |
| 2"                                                             | 280                | L.F. | 6.00        | 1,680.00    |
| 1"                                                             | 200                | L.F. | 4.00        | 800.00      |
| 4. Junction box                                                | 7                  | Ea.  | 65.00       | 455.00      |
| 5. Inductive loop                                              | 4                  | Ea.  | 250.00      | 1,000.00    |
| 6. Service                                                     | 1                  | Ea.  | 200.00      | 200.00      |
| 7. Street lighting                                             | 4                  | Ea.  | 900.00      | 3,600.00    |
| 8. Conduit and wiring - interconnect and street lighting       | 1,500              | L.F. | 4.00        | 6,000.00    |
| 9. Street excavation                                           | 563                | C.Y. | 3.00        | 1,689.00    |
| 10. Roadway construction                                       | 1,690              | S.Y. | 6.00        | 10,140.00   |
| 11. Concrete curb and gutter                                   | 1,662              | L.F. | 5.00        | 8,310.00    |
| 12. Type B curb                                                | 1,550              | L.F. | 3.00        | 4,650.00    |
| 13. Street striping and signing                                | 1                  | L.S. | 1,300.00    | 1,300.00    |
| 14. Guard rail                                                 | 60                 | L.F. | 7.50        | 450.00      |
| 15. Median island fill                                         | 644                | S.Y. | 3.00        | 1,932.00    |
| 16. Landscaping                                                | 1                  | L.S. | 400.00      | 400.00      |
| Sub Total                                                      |                    |      |             | \$53,606.00 |
| Contingencies, 10%                                             |                    |      |             | 5,361.00    |
|                                                                |                    |      |             | \$58,967.00 |
| Construction Engineering, 10%                                  |                    |      |             | 5,897.00    |
| GRAND TOTAL                                                    |                    |      |             | \$64,864.00 |



Brooks St. at Central, Regent, & Kent Streets

## INTRODUCTION

Brooks Street at Stephens Avenue is the only other existing signalized intersection along the "93 Strip". Stephens Street is a two-lane facility and serves an important connection function between Brooks Street and the Central Business District via Orange Street and carries an AADT of 8,500 at Brooks Street. The south leg serves 5,800 vehicles per day. With a two-year total of 32 reported accidents, this intersection is the highest accident location in the city and is ranked 8th on an accident rate basis. Poorly defined turning paths resulting from the skewed intersection geometry and the resultant large conflict area, inadequate signal visibility, the lack of a protected left-turn on the west approach of Brooks Street, and disruptive effect of traffic entering and exiting the shopping center adjacent to the south approach of Stephens Street are among factors contributing to the substantial hazard and traffic congestion at this location.

## SCOPE OF WORK

Major improvement features are the provision of a left-turn lane on the south approach of Brooks Street, widening of the north leg of Stephens Street to four-lanes, a new signal layout, and channelization. Traffic control is to be upgraded from the existing two-phase fixed-time control to full-actuated three-phase control with overlap for the heavy right-turn on the north approach of Stephens Avenue.

If the Brooks Street northbound left-turn movement increases to a point that the overall intersection capacity is greatly affected, the future phasing shown on the Improvement Diagram should be implemented and the median lane converted to an option left-through movement.

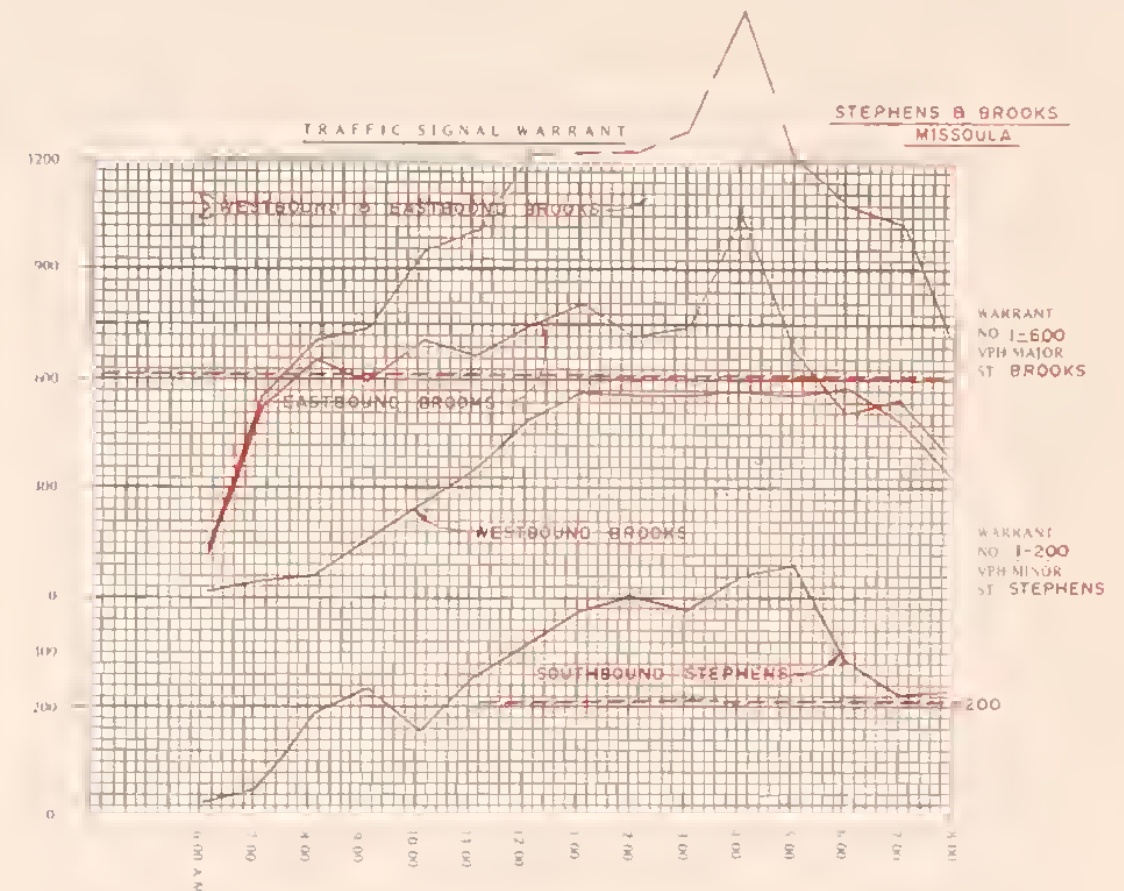
A trip generation and assignment analysis indicates that up to 3,000 trips could be diverted from the North Brooks Street through AADT and shifted to Stephens Avenue. Therefore a desirable ultimate design for the Brooks south approach would be to provide a double left-turn lane and two through lanes, but major right-of-way acquisition would be necessary. For the improvement as proposed, minor right-of-way will be required on three corners of the intersection.

As discussed hereinbefore, it is recommended that Stephens Avenue north of Brooks Street be signed as the route for U.S. 93, removing this designation from North Brooks Street and Higgins Avenue. Suggested directional signing in this regard is shown on the Improvement Diagram and includes a guide sign to Interstate 90.

## JUSTIFICATION

The high frequency of right-angle and rear end accidents at this location indicates that improved signal visibility as afforded by the proposed mast arm signal layout is necessary. The protected left-turn movement should eliminate the left-turn collision hazard that has existed (8 of the 32 accidents involved the Brooks Street northbound left-turn movement), and should provide a more desirable movement for U.S. 93 and CBD destined traffic.

As shown on the enclosed signal warrant sheet, the intersection satisfies Warrant No. 1.



## COLLISION DIAGRAM

CITY OF MISSOULA  
JAN. 1, - DEC. 31, 1970

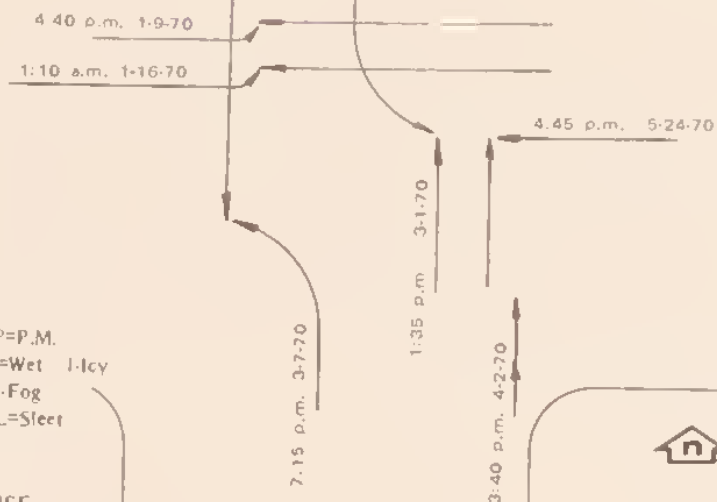
## LEGEND - SYMBOLS

Moving Vehicle →  
Backing Vehicle →  
Pedestrian - - - →  
Fatal ●  
Injury ○  
Parked Vehicle ☒  
Fixed Object □  
Overturned ○→  
Out of Control ~→

BROOKS ST.  
& STEPHENS AVE.

LOCATION

BROOKS ST.



## LEGEND

Time \_\_\_\_ A=A.M. P=P.M.  
Pavement · D=Dry W=Wet I-Icy  
Weather · C=Clear F=Fog  
R=Rain SL=Sleet  
S=Snow

## PROBABLE CAUSE

Exceeding Safe speed (ESS)  
Exceeding Speed limit (ESL)  
Ran Stop sign (RSS)  
Ran Signal (RS)  
Stopped, then proceeded (S&P)  
Following too close (FTC)  
Wrong side of road (WSR)  
Violated right of way (V/RW)  
Had been drinking (HBD)  
Did not see traffic (NSTC)  
Control Device  
Driving attention diverted (DAD)  
Mechanical Failure (MF)

## ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Dther       |       |      |      |       |      |      |       |      |      |

## COLLISION DIAGRAM

CITY OF MISSOULA  
JAN. 1, - DEC. 31, 1970

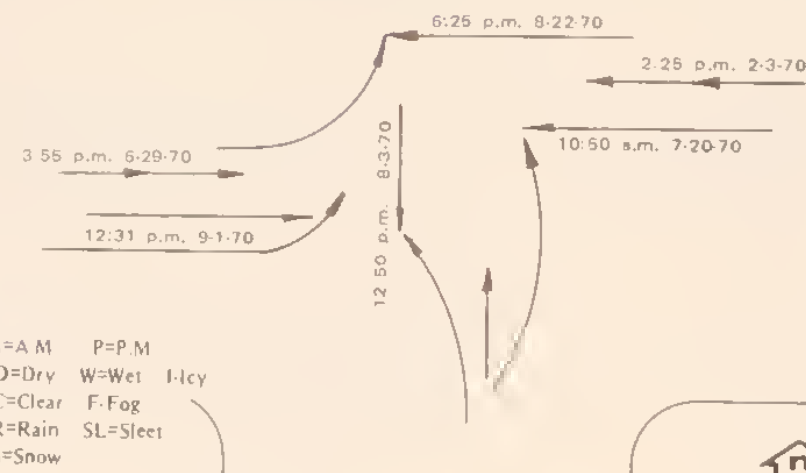
## LEGEND - SYMBOLS

Moving Vehicle →  
Backing Vehicle →  
Pedestrian - - - →  
Fatal ●  
Injury ○  
Parked Vehicle ☒  
Fixed Object □  
Overturned ○→  
Out of Control ~→

BROOKS ST.  
& STEPHENS AVE.

LOCATION

BROOKS ST.



## LEGEND

Time \_\_\_\_ A=A.M. P=P.M.  
Pavement · D=Dry W=Wet I-Icy  
Weather · C=Clear F=Fog  
R=Rain SL=Sleet  
S=Snow

## PROBABLE CAUSE

Exceeding Safe speed (ESS)  
Exceeding Speed limit (ESL)  
Ran Stop sign (RSS)  
Ran Signal (RS)  
Stopped, then proceeded (S&P)  
Following too close (FTC)  
Wrong side of road (WSR)  
Violated right of way (V/RW)  
Had been drinking (HBD)  
Did not see traffic (NSTC)  
Control Device  
Driving attention diverted (DAD)  
Mechanical Failure (MF)

## ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Dther       |       |      |      |       |      |      |       |      |      |

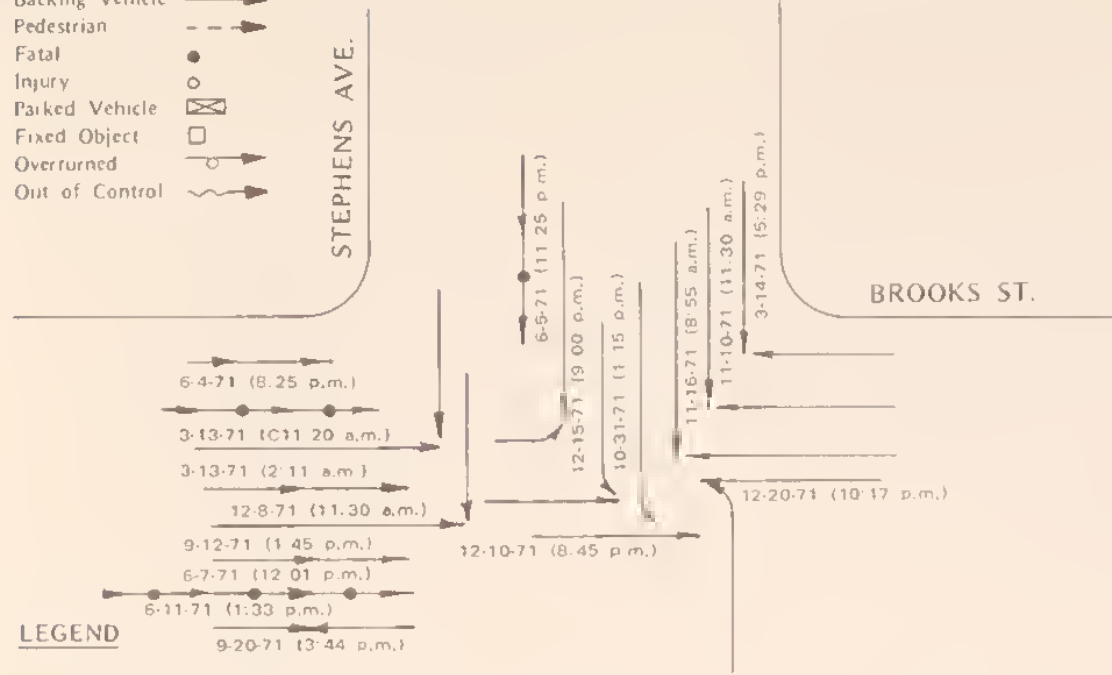


# COLLISION DIAGRAM

CITY OF MISSOULA  
JAN 1, 1971 - DEC. 31, 1971

## LEGEND - SYMBOLS

- Moving Vehicle →
- Backing Vehicle →
- Pedestrian →
- Fatal ●
- Injury ○
- Parked Vehicle ☒
- Fixed Object □
- Overturned ○→
- Out of Control ~→



## LEGEND

Time \_\_\_\_ A=A M P=P M  
Pavement : D=Dry W=Wet I=Icy  
Weather : C=Clear F=Fog  
R=Rain SL=Sleet  
S=Snow

## PROBABLE CAUSE

Exceeding Safe speed (ESS)  
Exceeding Speed limit (ESL)  
Ran Stop sign (RSS)  
Ran Signal (RS)  
Stopped, then proceeded (S&P)  
Following too close (FTC)  
Wrong side of road (WSR)  
Violated right of way (V/RW)  
Had been drinking (HBD)  
Did not see traffic (NSTC)  
Control Device  
Driving attention diverted (DAD)  
Mechanical Failure (MF)

## ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |

# COLLISION DIAGRAM

CITY OF MISSOULA  
JAN. 1, - DEC. 31, 1970

## LEGEND - SYMBOLS

- Moving Vehicle →
- Backing Vehicle →
- Pedestrian →
- Fatal ●
- Injury ○
- Parked Vehicle ☒
- Fixed Object □
- Overturned ○→
- Out of Control ~→



## LEGEND

Time \_\_\_\_ A=A M P=P M  
Pavement : D=Dry W=Wet I=Icy  
Weather : C=Clear F=Fog  
R=Rain SL=Sleet  
S=Snow

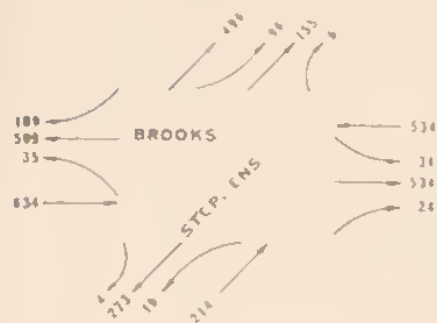
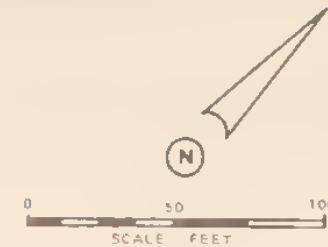
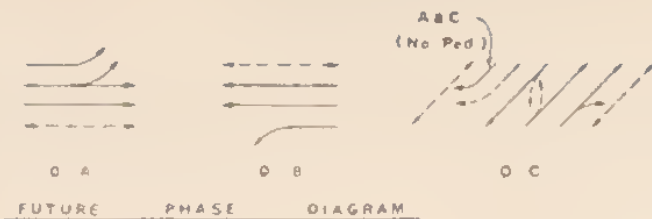
## PROBABLE CAUSE

Exceeding Safe speed (ESS)  
Exceeding Speed limit (ESL)  
Ran Stop sign (RSS)  
Ran Signal (RS)  
Stopped, then proceeded (S&P)  
Following too close (FTC)  
Wrong side of road (WSR)  
Violated right of way (V/RW)  
Had been drinking (HBD)  
Did not see traffic (NSTC)  
Control Device  
Driving attention diverted (DAD)  
Mechanical Failure (MF)

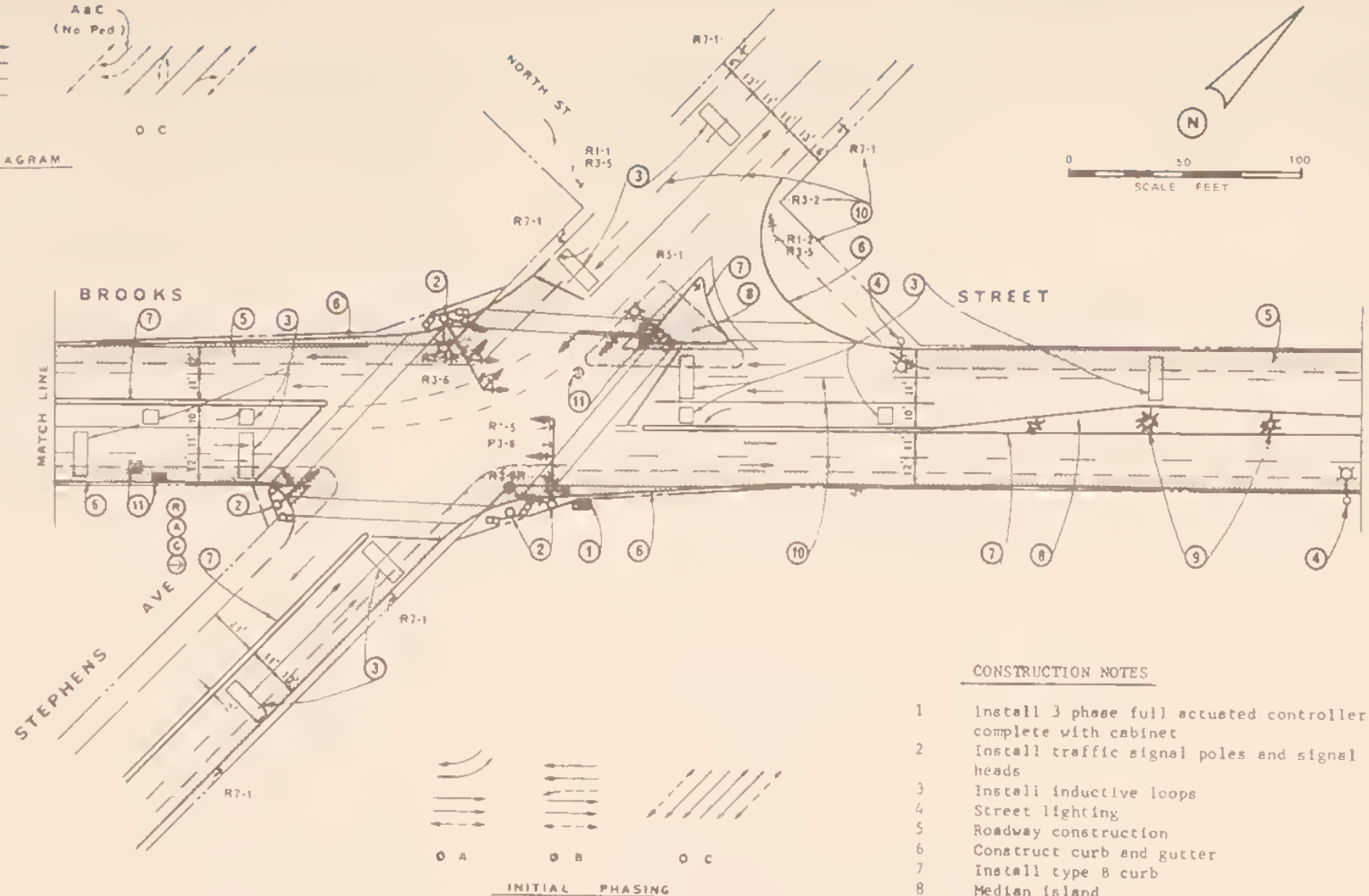
## ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |





Turning Movement Counts  
12:00 - 1:00 p.m.  
August 25, 1972



#### CONSTRUCTION NOTES

- 1 Install 3 phase full actuated controller complete with cabinet
- 2 Install traffic signal poles and signal heads
- 3 Install inductive loops
- 4 Street lighting
- 5 Roadway construction
- 6 Construct curb and gutter
- 7 Install type B curb
- 8 Median island
- 9 Landscaping
- 10 Street striping and signing
- 11 Relocate existing drains

### Street Improvements & Traffic Signals Brooks St. & Stephens Ave.

BROOKS STREET AND STEPHENS AVENUE

COST ESTIMATE

| Description                                                     | Estimated Quantity | Unit | Unit Cost   | Total Cost  | Description                                   | Estimated Quantity | Unit | Unit Cost | Total Cost      |
|-----------------------------------------------------------------|--------------------|------|-------------|-------------|-----------------------------------------------|--------------------|------|-----------|-----------------|
| 1. Install 3 phase fully-actuated controller, complete in place | 1                  | Ea.  | \$ 8,000.00 | \$ 8,000.00 | 14. Median island fill                        | 211                | S.Y. | 3.00      | 633.00          |
| 2. Traffic signal poles & signal head                           | 3                  | Ea.  | 3,400.00    | 10,200.00   | 15. Landscaping                               | 3                  | Ea.  | 50.00     | 150.00          |
| 35' Mast Arm                                                    | 3                  | Ea.  | 3,400.00    | 10,200.00   | 16. Remove existing signal system and salvage | 1                  | L.S. | 400.00    | <u>400.00</u>   |
| Post top mount                                                  | 1                  | Ea.  | 900.00      | 900.00      |                                               |                    |      |           |                 |
| 3. Conduit and conductors                                       |                    |      |             |             |                                               |                    |      |           |                 |
| 2"                                                              | 300                | L.F. | 6.00        | 1,800.00    | Sub Total                                     |                    |      |           | \$ 49,108.00    |
| 1"                                                              | 580                | L.F. | 4.00        | 2,320.00    | Contingencies, 10%                            |                    |      |           | 4,911.00        |
| 4. Junction boxes                                               | 7                  | Ea.  | 65.00       | 455.00      |                                               |                    |      |           | \$ 54,019.00    |
| 5. Inductive loops                                              | 8                  | Ea.  | 250.00      | 2,000.00    | Construction Engineering, 10%                 |                    |      |           | <u>5,402.00</u> |
| 6. Service                                                      | 1                  | Ea.  | 200.00      | 200.00      |                                               |                    |      |           |                 |
| 7. Street lighting                                              | 2                  | Ea.  | 900.00      | 1,800.00    | GRAND TOTAL                                   |                    |      |           | \$ 59,421.00    |
| 8. Conduit and wiring, interconnect and street lighting         | 960                | L.F. | 4.00        | 3,840.00    |                                               |                    |      |           |                 |
| 9. Street excavation                                            | 324                | C.Y. | 3.00        | 972.00      |                                               |                    |      |           |                 |
| 10. Roadway construction                                        | 973                | S.Y. | 6.00        | 5,838.00    |                                               |                    |      |           |                 |
| 11. Concrete curb and gutter                                    | 1,250              | L.F. | 5.00        | 6,250.00    |                                               |                    |      |           |                 |
| 12. Type B curb                                                 | 950                | L.F. | 3.00        | 2,850.00    |                                               |                    |      |           |                 |
| 13. Street striping and signing                                 | 1                  | L.S. | 500.00      | 500.00      |                                               |                    |      |           |                 |

## INTRODUCTION

Kensington Avenue and Holborn Street are lightly traveled local streets creating a skewed six-leg intersection with Brooks Street. Seven accidents were reported for this location in the 1970-1971 period.

## SCOPE OF WORK

As shown on the Improvement Diagram, median channelization needed in connection with proposed improvements at the adjacent intersections on Brooks Street at Stephens Avenue and at Strand Avenue is carried through to this intersection. The north side of the intersection is channelized to permit one-way entry into Kensington from the southbound Brooks Street roadway, and Holborn Street and Kensington Avenue are designated for one-way operation in a westerly direction. The south leg of Holborn Street is converted to a cul-de-sac street, and the south leg of Kensington Avenue is channelized for right-turn-only movements. Minor amounts of right-of-way will be required on both legs of Kensington Avenue.

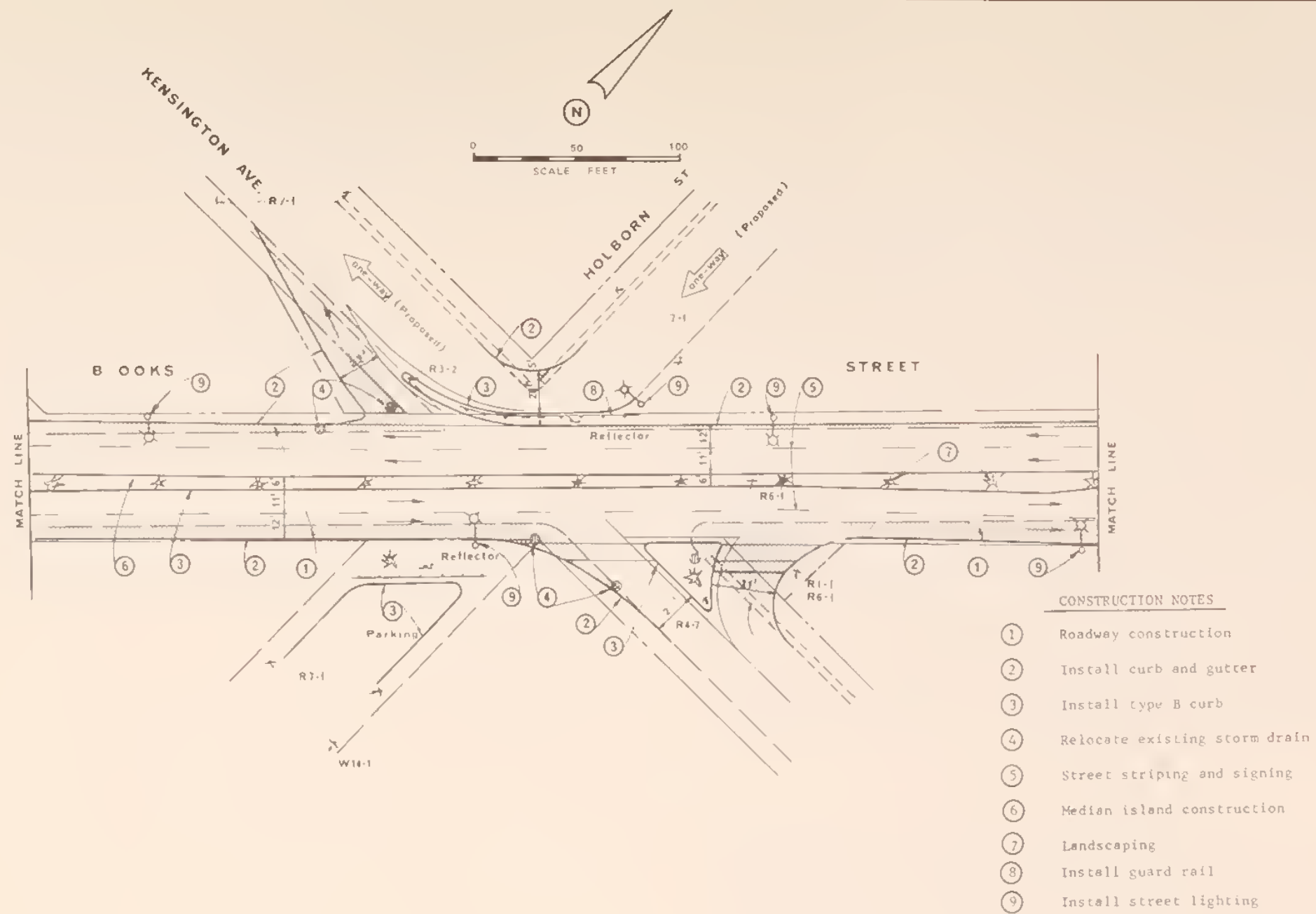
## JUSTIFICATION

The above improvements are consistent with the objectives to restrict and channelize access to and from Brooks Street and to remove the existing complex pattern of conflicting traffic movements. The proposed improvement will eliminate the pattern of right-angle collisions involving these local streets and Brooks Street.

The restricted access pattern and one-way street element will not work any hardship upon adjacent business since suitable alternate access is available.

## COST ESTIMATE

| Description                                                 | Estimated Quantity | Unit | Unit Cost | Total Cost  |
|-------------------------------------------------------------|--------------------|------|-----------|-------------|
| 1. Street excavation                                        | 309                | C.Y. | \$ 3.00   | \$ 927.00   |
| 2. Roadway construction                                     | 927                | S.Y. | 6.00      | 5,562.00    |
| 3. Concrete curb and gutter                                 | 800                | L.F. | 5.00      | 4,000.00    |
| 4. Type B curb                                              | 1,620              | L.F. | 3.00      | 4,860.00    |
| 5. Median island fill                                       | 378                | S.Y. | 3.00      | 1,134.00    |
| 6. Landscaping                                              | 1                  | L.S. | 500.00    | 500.00      |
| 7. Street lighting                                          | 5                  | Ea.  | 900.00    | 4,500.00    |
| 8. Conduit and wiring -<br>interconnect and street lighting | 1,150              | L.F. | 4.00      | 4,600.00    |
| 9. Guard rail                                               | 80                 | L.F. | 7.00      | 560.00      |
| 10. Relocate storm drain                                    | 2                  | Ea.  | 200.00    | 400.00      |
| 11. Street striping and signing                             | 1                  | L.S. | 600.00    | 600.00      |
| Sub Total                                                   |                    |      |           | \$27,643.00 |
| Contingencies, 10%                                          |                    |      |           | 2,764.00    |
|                                                             |                    |      |           | \$30,407.00 |
| Construction Engineering, 10%                               |                    |      |           | 3,041.00    |
| GRAND TOTAL                                                 |                    |      |           | \$33,448.00 |



**Street Improvements**  
**Brooks St. & Kensington Ave. & Holborn St.**

## Brooks Street: Strand Avenue, Bow Street, and Burlington Avenue

### INTRODUCTION

Strand Avenue and Bow Street are presently lightly traveled streets forming a six-leg skewed intersection with Brooks Street. However, Strand Avenue is designated as a Primary Type II Street in order to provide an arterial link between Bancroft and Russell Streets and to provide secondary access along the northern boundary of the commercial area under the proposed circulation plan for the entire area. Seven accidents were reported involving Strand Avenue and four accidents involving Bow Street for 1970-1971. Burlington Avenue is a lightly traveled local street a short distance to the north on Brooks Street.

### SCOPE OF WORK

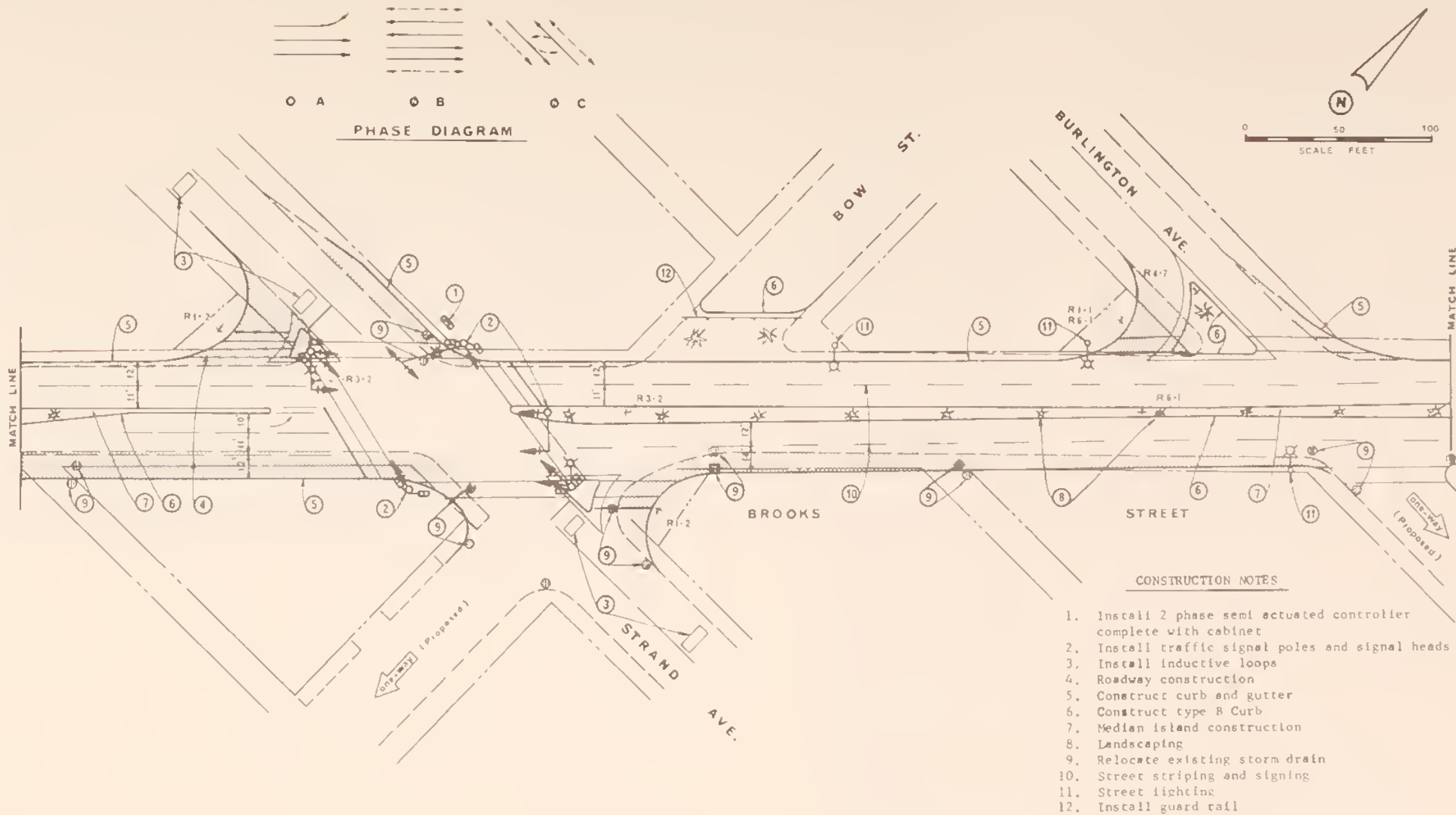
Three-phase traffic actuated signal control is to be provided at Strand Avenue. A protected phase is provided for the left-turn movement from northbound Brooks Street to westbound Strand Avenue. Since a Brooks Street southbound left-turn movement is provided at Bancroft Street, the left-turn is prohibited at Strand Avenue because of the large conflict area it would create. Channelization together with conversion of the north leg of Bow Street to a cul-de-sac street and conversion of the south leg of Bow Street to one-way southbound to Kensington Avenue is also recommended. At Burlington Avenue the north leg of Burlington Avenue is channelized for right-turn-only movement, and the south leg is converted to one-way operation to Bancroft Street (see also "Brooks Street at Mount Avenue and Bancroft Street"). Minor right-of-way acquisition is required on both legs of Strand Avenue, the north approach of Burlington Street, and the south approach of Brooks Street. The latter right-of-way requirement and the narrowing of the median near Burlington Street is necessitated by lack of adequate setbacks to buildings near Kensington Street and design treatments at Kensington Street.

### JUSTIFICATION

Signalization at Strand Avenue is necessary to provide access to Brooks Street for traffic movements which are to be prohibited at nearby local street intersections with Brooks Street. In addition, Strand Avenue will serve a connector function between Brooks, Bancroft, and Russell Streets, providing a by-pass of the heavily used Brooks Street/Russell Street/ South Avenue intersection for traffic moving between north Russell Street and the north end of the commercial strip. The revised traffic pattern stemming from the various improvements along Brooks Street should produce traffic volumes which will satisfy Warrant No. 1 and/or Warrant No. 2 for installation of the proposed signal.

The proposed improvements should largely eliminate the pattern of left-turn and angle accidents which constitute most of the accidents at Strand Avenue and Bow Street. The proposed improvements at Burlington are desirable in connection with general access control needs for Brooks Street. Access needs served by the eliminated turning movements at these locations are adequately provided for via Strand and Mount Avenues.





Street Improvements & Traffic Signals  
Brooks St., Strand Ave., Burlington Ave. & Bow St.

BROOKS AVENUE AND STRAND AVENUE

COST ESTIMATE

| <u>Description</u>                                     | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u> | <u>Description</u>                                      | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|--------------------------------------------------------|-------------------------------|-------------|------------------|-------------------|---------------------------------------------------------|-------------------------------|-------------|------------------|-------------------|
| 1. Install 3 phase semi-actuated controller            | 1                             | Ea.         | \$ 3,500.00      | \$ 3,500.00       | 13. Conduit and wiring-interconnect and street lighting | 1,310                         | L.F.        | 4.00             | 5,240.00          |
| 2. Traffic signal poles and heads, complete, installed |                               |             |                  |                   | 14. Relocate storm drains                               | 5                             | Ea.         | 200.00           | 1,000.00          |
| 20' Mast Arm                                           | 2                             | Ea.         | 2,200.00         | 4,400.00          | 15. Street striping and signing                         | 1                             | L.S.        | 600.00           | 600.00            |
| 30' Mast Arm                                           | 1                             | Ea.         | 3,000.00         | 3,000.00          | 16. Landscaping                                         | 9                             | Ea.         | 50.00            | <u>450.00</u>     |
| Post mount                                             | 2                             | Ea.         | 1,200.00         | 2,400.00          |                                                         |                               |             |                  |                   |
| 3. Conduit and wiring                                  |                               |             |                  |                   | Sub Total                                               |                               |             |                  | \$46,988.00       |
| 2"                                                     | 310                           | L.F.        | 6.00             | 1,860.00          | Contingencies, 10%                                      |                               |             |                  | <u>4,699.00</u>   |
| 1"                                                     | 210                           | L.F.        | 4.00             | 840.00            |                                                         |                               |             |                  |                   |
| 4. Junction box                                        | 7                             | Ea.         | 65.00            | 455.00            |                                                         |                               |             |                  | \$51,687.00       |
| 5. Inductive loop                                      | 4                             | Ea.         | 250.00           | 1,000.00          | Construction Engineering, 10%                           |                               |             |                  | <u>5,169.00</u>   |
| 6. Service                                             | 1                             | Ea.         | 200.00           | 200.00            | GRAND TOTAL                                             |                               |             |                  | \$56,856.00       |
| 7. Street excavation                                   | 410                           | C.Y.        | 3.00             | 1,230.00          |                                                         |                               |             |                  |                   |
| 8. Roadway construction                                | 1,230                         | S.Y.        | 6.00             | 7,380.00          |                                                         |                               |             |                  |                   |
| 9. Concrete curb and gutter                            | 1,150                         | L.F.        | 5.00             | 5,750.00          |                                                         |                               |             |                  |                   |
| 10. Type B curb                                        | 1,290                         | L.F.        | 3.00             | 3,870.00          |                                                         |                               |             |                  |                   |
| 11. Median island fill                                 | 371                           | S.Y.        | 3.00             | 1,113.00          |                                                         |                               |             |                  |                   |
| 12. Street lighting                                    | 3                             | Ea.         | 900.00           | 2,700.00          |                                                         |                               |             |                  |                   |

INTRODUCTION

Mount Avenue constitutes the central portion of an east-west connector consisting of Beckwith Street, Mount Avenue, and Knowles Street and serves traffic needs for the University Area to the east as well as the "93 Strip" area. Brooks Street AADT falls to approximately 15,000 in this area and transitions to a two-lane section north of the intersection. Mount Avenue has an AADT of 2,600. Bancroft Street begins at Brooks Street a short distance south of Mount Avenue. With an AADT of 2,000, Bancroft serves an important collector function and provides access to a nearby shopping center, and medical office complex and to Sentinel High School.

SCOPE OF WORK

Install a two-phase semi-actuated traffic signal with pedestrian indications at Mount Avenue. Median channelization for Brooks Street ends on the north leg for which a protected left-turn lane is provided. Channelization provides an optional left-through lane on the south approach of Brooks Street, and a left-turn lane for traffic destined to Bancroft Street. Proposed signal control at nearby Strand Avenue will insure adequate gap availability for the latter left-turn movement. Widening is required on the north leg of Brooks Street to accommodate the channelization and provide a transition from the two-lane roadway north to Mount Avenue to the four-lane roadway south of Mount Avenue. It is recommended that the virtually unused short section of Addison Street between Mount Avenue and Woodford Street be closed at Mount Avenue.

JUSTIFICATION

While no strong accident pattern exists at this location, the proposed channelization and signalization should reduce potential conflicts and generally improve traffic safety. The existing traffic level on Mount Avenue and Brooks Street meets Warrant No. 2 for signalization for eight hours of the day, and traffic can be expected to increase on Mount Avenue as a result of proposed improvements at other locations in the area. (See Traffic Signal Warrant.)

Although 1972 accident data is not analyzed for this report, it should be noted that the annual number of accidents doubled from an average of 4.5 reported in 1970-1971 to 10 reported in 1971.

LEGEND - SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Pedestrian
- Fatal
- Injury
- Parked Vehicle
- Fixed Object
- Overtaken
- Out of Control

BROOKS

6-7-71 (7:30 p.m.)

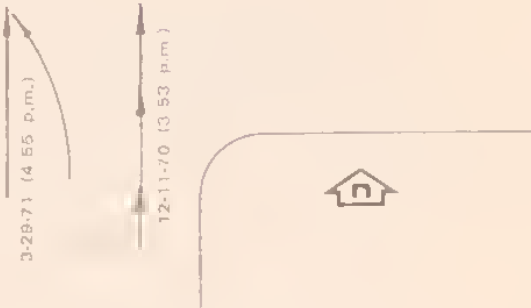
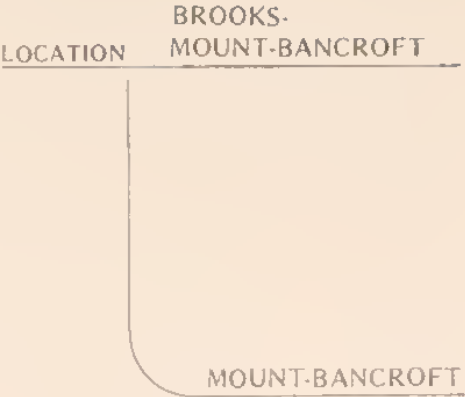
LEGEND

- Time A=A.M. P=P.M.
- Pavement D=Dry W=Wet I-Icy
- Weather C=Clear F-Fog
- R=Rain SL=Sleet
- S=Snow

PROBABLE CAUSE

- Exceeding Safe speed (ESS)
- Exceeding Speed limit (ESL)
- Ran Stop sign (RSS)
- Ran Signal (RS)
- Stopped, then proceeded (S&P)
- Following too close (FTC)
- Wrong side of road (WSR)
- Violated right of way (V/RW)
- Had been drinking (HBD)
- Did not see traffic (NSTC)
- Control Device
- Driving attention diverted (DAD)
- Mechanical Failure (MF)

COLLISION DIAGRAM  
CITY OF MISSOULA  
1970 to 1971



ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |

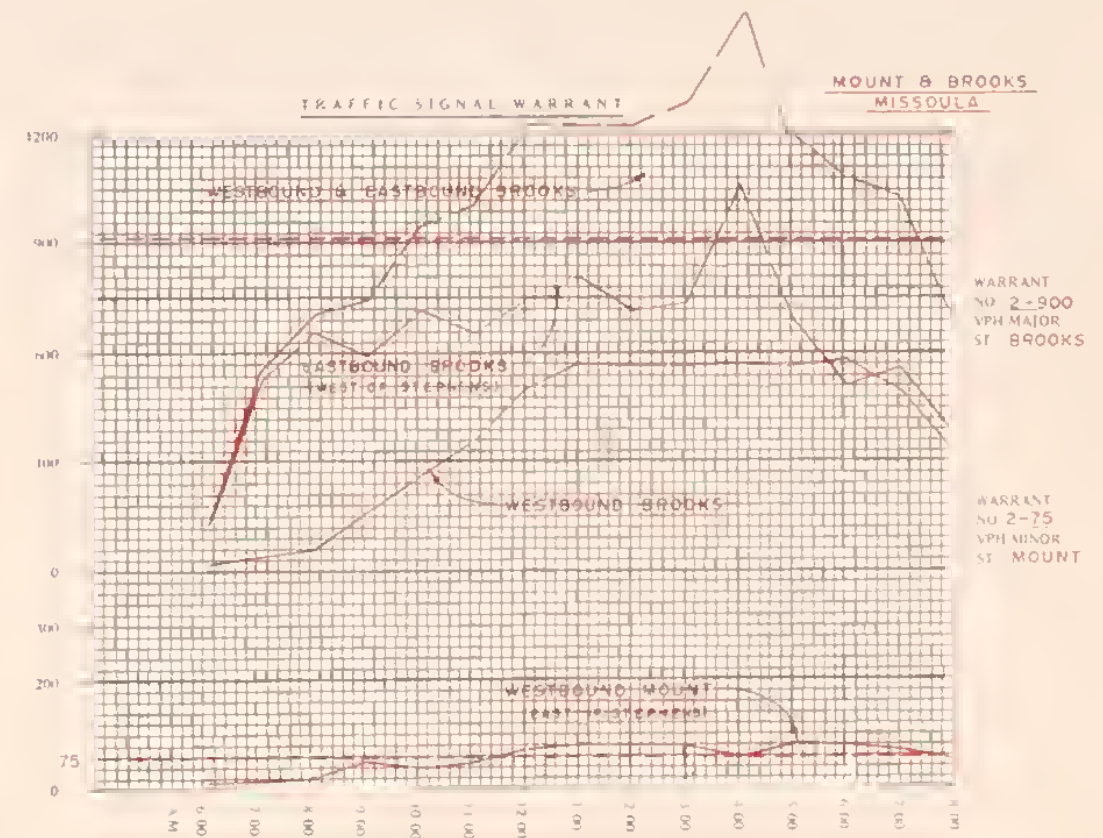


# BROOKS AVENUE AND MOUNT AVENUE

## COST ESTIMATE

| Description                                           | Estimated Quantity | Unit | Unit Cost | Total Cost |
|-------------------------------------------------------|--------------------|------|-----------|------------|
| 1. Install 2 phase semi-actuated controller complete  | 1                  | Ea.  | 3,500.00  | 3,500.00   |
| 2. Traffic signal pole complete, installed            |                    |      |           |            |
| 20' Mast Arm                                          | 2                  | Ea.  | 2,200.00  | 4,400.00   |
| 30' Mast Arm                                          | 1                  | Ea.  | 2,800.00  | 2,800.00   |
| Post top                                              | 2                  | Ea.  | 900.00    | 1,800.00   |
| 3. Conduit and wiring                                 |                    |      |           |            |
| 2"                                                    | 300                | L.F. | 6.00      | 1,800.00   |
| 1"                                                    | 160                | L.F. | 3.00      | 480.00     |
| 4. Junction box                                       | 7                  | Ea.  | 65.00     | 455.00     |
| 5. Inductive loop                                     | 4                  | Ea.  | 250.00    | 1,000.00   |
| 6. Service                                            | 1                  | Ea.  | 200.00    | 200.00     |
| 7. Street excavation                                  | 410                | C.Y. | 3.00      | 1,230.00   |
| 8. Roadway construction                               | 1,230              | S.Y. | 6.00      | 7,380.00   |
| 9. Concrete curb and gutter                           | 1,150              | L.F. | 5.00      | 5,750.00   |
| 10. Type B curb                                       | 1,290              | L.F. | 3.00      | 3,870.00   |
| 11. Median island fill                                | 236                | S.Y. | 3.00      | 708.00     |
| 12. Street lighting                                   | 3                  | Ea.  | 900.00    | 2,700.00   |
| 13. Conduit and wiring - interconnect street lighting | 1,030              | L.F. | 4.00      | 4,120.00   |

| Description                     | Estimated Quantity | Unit | Unit Cost | Total Cost  |
|---------------------------------|--------------------|------|-----------|-------------|
| 14. Landscaping                 | 5                  | Ea.  | 50.00     | 250.00      |
| 15. Relocate storm drain        | 1                  | Ea.  | 250.00    | 250.00      |
| 16. Street striping and signing | 1                  | L.S. | 600.00    | 600.00      |
| Sub Total                       |                    |      |           | \$43,293.00 |
| Contingencies, 10%              |                    |      |           | 4,329.00    |
|                                 |                    |      |           | \$47,622.00 |
| Construction Engineering, 10%   |                    |      |           | 4,762.00    |
| GRAND TOTAL                     |                    |      |           | \$52,384.00 |





## INTRODUCTION

Currently Stephens Avenue is striped for two lanes and carries an AADT of 8,500 while Strand Avenue is a lightly traveled local street. As proposed elsewhere in this report, Stephens Avenue would be striped for four-lanes and signed as U.S. 93, which should result in increased traffic on this important arterial. Proposed improvements on Brooks Street, including signalization of Strand Avenue at Brooks Street will result in significantly increased traffic on Strand Avenue. With present control via stop-signs on Strand Avenue, this location has experienced nine accidents for the 1970-1971 period.

## SCOPE OF WORK

Install a semi-actuated two-phase traffic signal at the time that the Brooks street improvements are implemented. Pedestrian indications are provided along with improved street lighting. Additional right-of-way is not required.

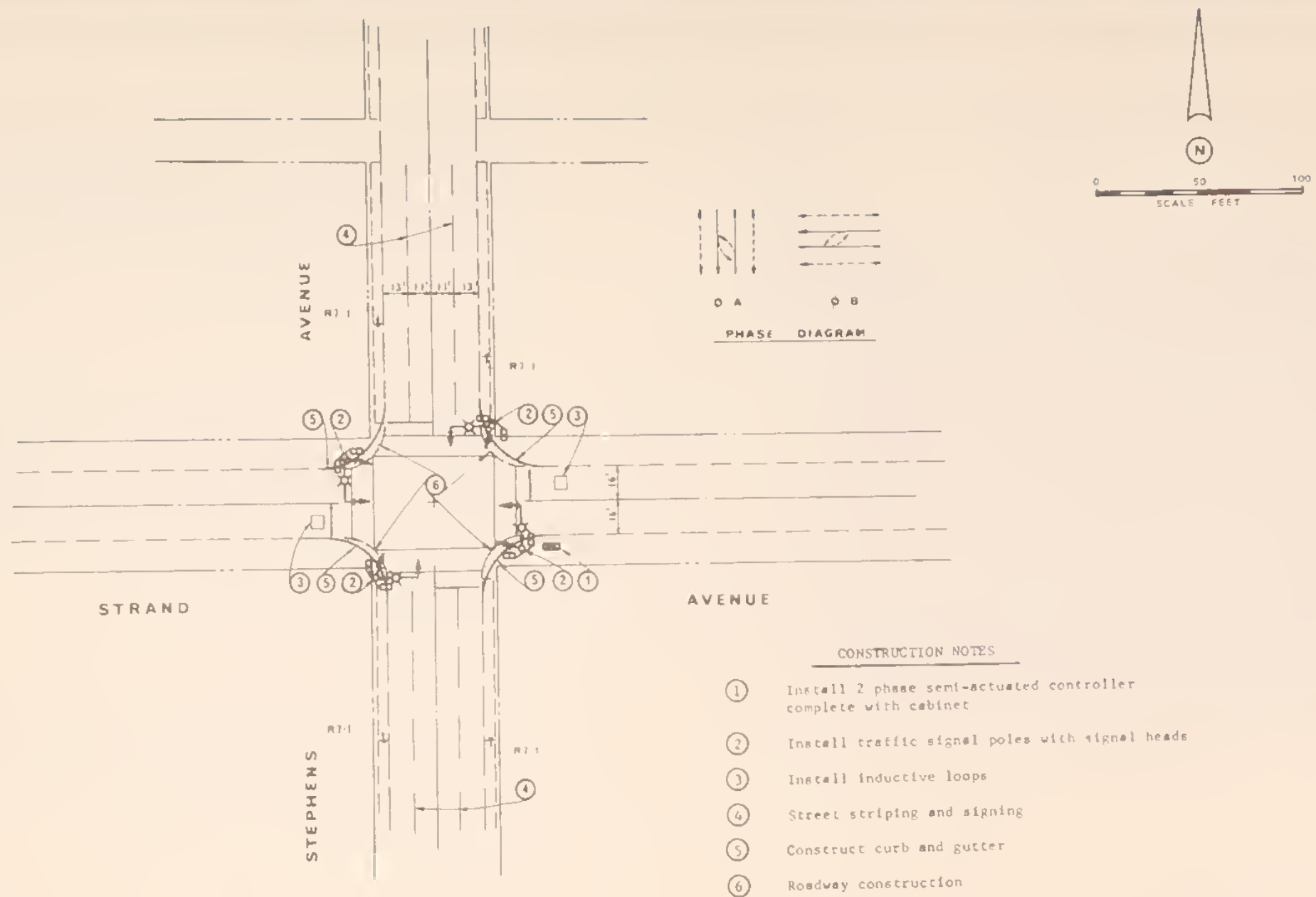
## JUSTIFICATION

Under the present configuration of Stephens Avenue as a two-lane facility, the intersection meets Warrant No. 2 for 7 of the required 8 hours (See Warrant Sheet). However, increased traffic volumes on both streets stemming from the Brooks Street improvement projects coupled with the four-laning of Stephens Avenue, signalization will be warranted at this location. Six of the nine accidents have occurred at night indicating that the street lighting improvements should be made as soon as possible.

## STEPHENS AVENUE AND STRAND AVENUE

### COST ESTIMATE

| Description                                                               | Estimated Quantity | Unit | Unit Cost   | Total Cost          |
|---------------------------------------------------------------------------|--------------------|------|-------------|---------------------|
| 1. 2-Phase semi-actuated controller complete in place                     | 1                  | Ea.  | \$ 3,500.00 | \$ 3,500.00         |
| 2. Traffic signal poles and signal heads 20' Mast Arm                     | 4                  | Ea.  | 2,200.00    | 8,800.00            |
| 3. Conduit and wiring 2"                                                  | 210                | L.F. | 6.00        | 1,260.00            |
| 1"                                                                        | 60                 | L.F. | 3.00        | 180.00              |
| 4. Junction boxes                                                         | 6                  | Ea.  | 65.00       | 390.00              |
| 5. Inductive loops                                                        | 4                  | Ea.  | 250.00      | 1,000.00            |
| 6. Service                                                                | 1                  | Ea.  | 200.00      | 200.00              |
| 7. Street striping and signing Mount Avenue to Brooks Avenue              | 1                  | L.S. | 1,200.00    | 1,200.00            |
| 8. Street excavation                                                      | 24                 | C.Y. | 3.00        | 72.00               |
| 9. Roadway construction                                                   | 71                 | S.Y. | 6.00        | 426.00              |
| 10. Concrete curb and gutter                                              | 160                | L.F. | 7.50        | 1,200.00            |
| 11. Street lighting - Mount to Brooks                                     | 6                  | Ea.  | 9.00        | 5,400.00            |
| 12. Conduit and wiring - interconnect and street lighting Mount to Brooks | 800                | L.F. | 4.00        | <u>3,200.00</u>     |
| Sub Total                                                                 |                    |      |             | \$ 26,828.00        |
| Contingencies, 10%                                                        |                    |      |             | 2,683.00            |
| Construction Engineering, 10%                                             |                    |      |             | <u>\$ 29,511.00</u> |
| GRAND TOTAL                                                               |                    |      |             | \$ 32,462.00        |



Traffic Signals  
Stephens Ave. & Strand Ave.

## INTRODUCTION

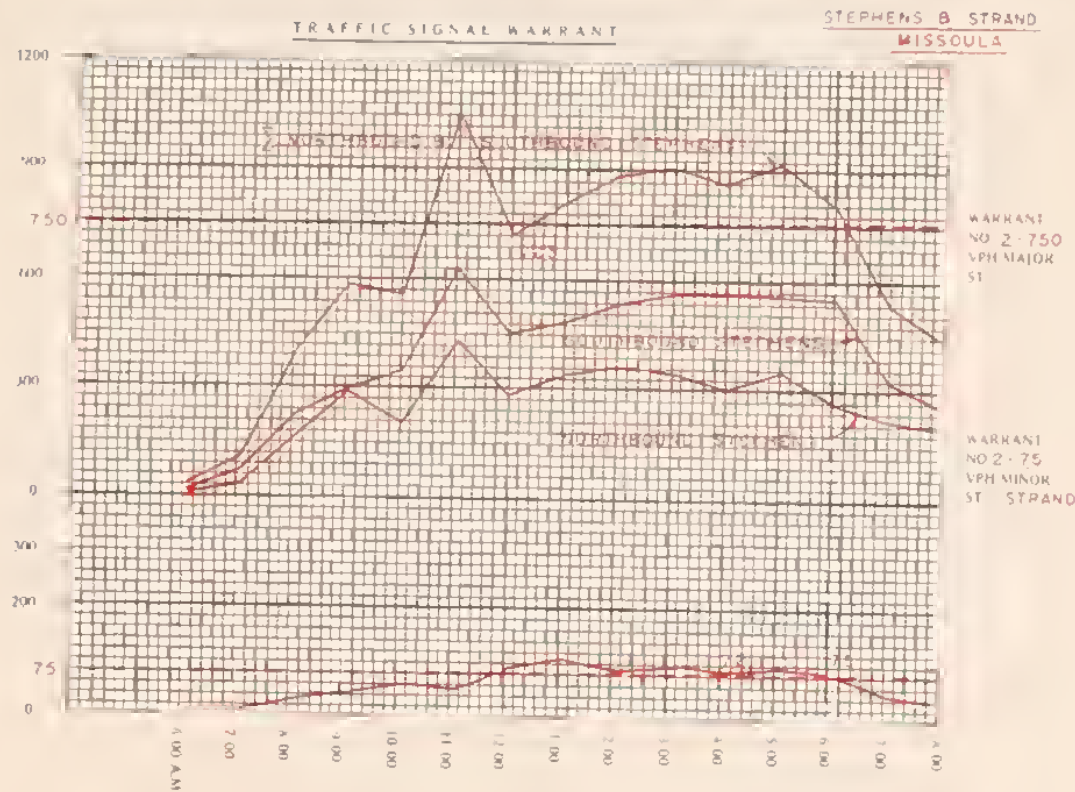
Stephens Avenue is an important north-south arterial, while Mount Avenue and Knowles Street provide a secondary east-west cross-town connector function for south-central Missoula. Stephens Avenue carries AADT's of 10,400 and 8,500 on its north and south leg, respectively. Knowles Street has an AADT of 5,500 while Mount Avenue carries 2,600 vehicles per day. Despite the geometric complexity of this skewed multileg intersection, only two accidents were reported for 1970-1971.

## SCOPE OF WORK

It is recommended that the present "jog" between Knowles Street and the east leg of Mount Avenue be removed by realigning the east leg of Mount Avenue into the extension of Knowles Street. The west leg of Mount Avenue is to be realigned into Knowles Street in a manner which will in effect convert traffic flow on Mount Avenue to one-way operation. Two-phase (expandable to three-phases) semi-actuated traffic signals are to be installed. Pedestrian indications are provided and traffic signal poles are located to allow for possible future widening for left-turn lanes on Stephens Avenue. Channelization improvements are also shown on the Improvement Diagram. No additional right-of-way is required to implement this project.

## JUSTIFICATION

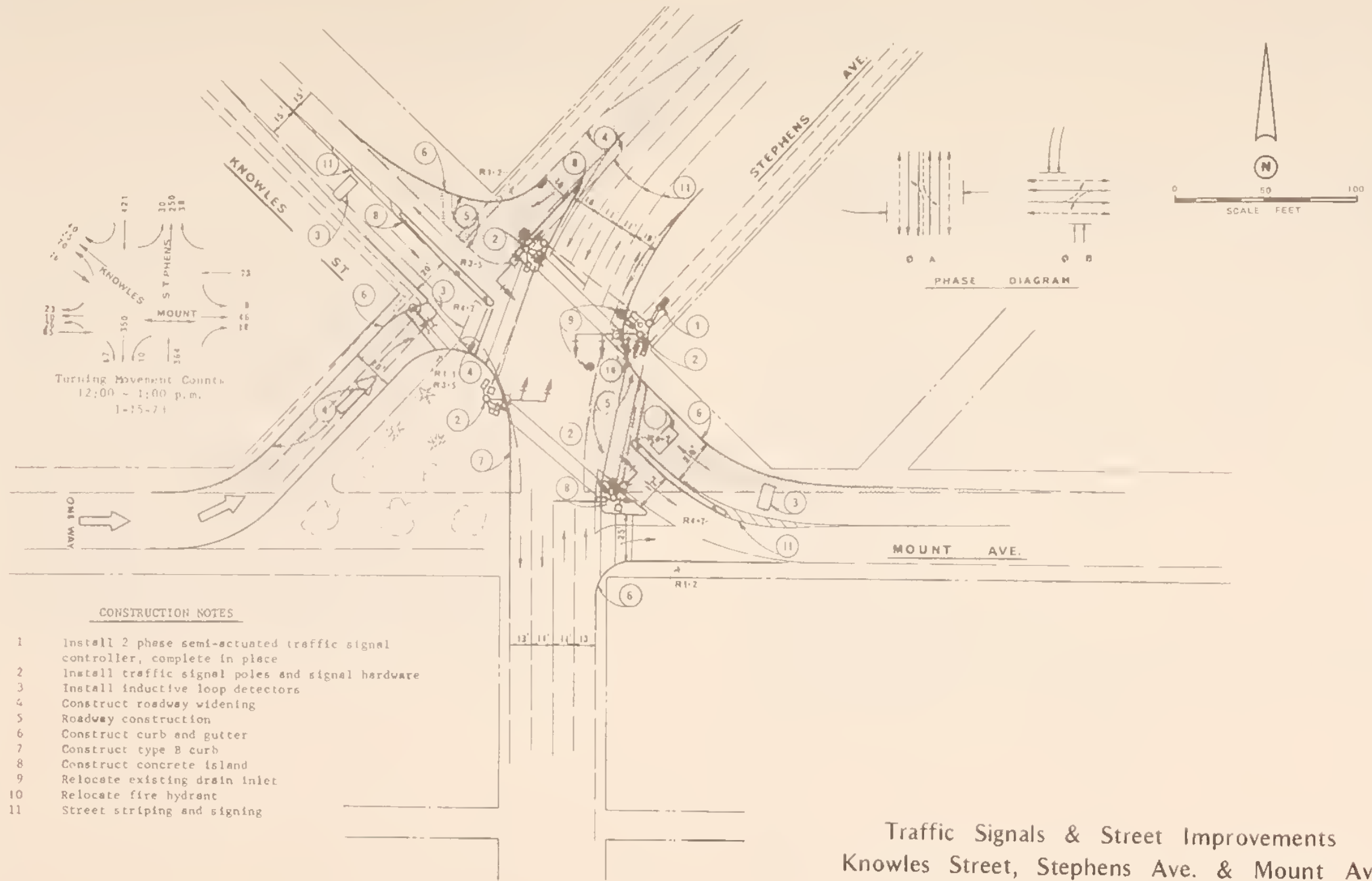
The proposed realignments, channelization and signalization will facilitate Knowles Street-Mount Avenue traffic, provide improved guidance to Stephens Avenue traffic, and facilitate an effective signal layout with an efficient two-phase operation. Current traffic volumes meet Warrant No. 2 (See Signal Warrant Sheet) for a signal control for 8 hours, and the proposed upgrading of Stephens Avenue to a four-lane facility to be signed as U.S. 93 will further increase the need for signals.



STEPHENS AVENUE AND KNOWLES STREET-MOUNT AVENUE

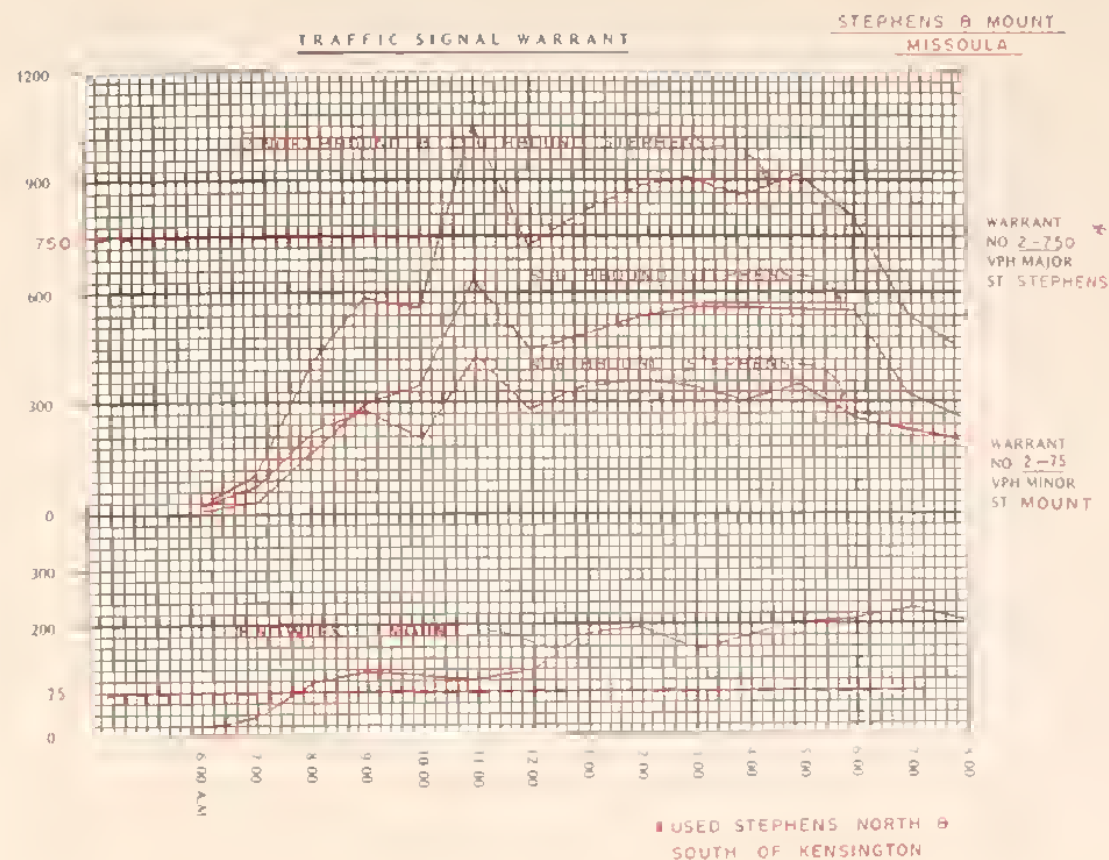
COST ESTIMATE

| Description                                                                | Estimated Quantity | Unit | Unit Cost   | Total Cost  | Description                   | Estimated Quantity | Unit | Unit Cost | Total Cost  |
|----------------------------------------------------------------------------|--------------------|------|-------------|-------------|-------------------------------|--------------------|------|-----------|-------------|
| 1. 3-Phase semi-actuated controller, complete, installed with interconnect | 1                  | Ea.  | \$ 3,800.00 | \$ 3,800.00 | 14. Relocate fire hydrant     | 1                  | Ea.  | 400.00    | 400.00      |
| 2. Traffic signal poles complete, installed with luminaires                |                    |      |             |             | 15. Remove street light       | 1                  | Ea.  | 200.00    | 200.00      |
| 20' Mast Arm                                                               | 1                  | Ea.  | 2,200.00    | 2,200.00    | Sub Total                     |                    |      |           | \$39,735.00 |
| 25' Mast Arm                                                               | 1                  | Ea.  | 2,400.00    | 2,400.00    | Contingencies, 10%            |                    |      |           | 3,974.00    |
| 30' Mast Arm                                                               | 1                  | Ea.  | 3,000.00    | 3,000.00    |                               |                    |      |           | \$43,709.00 |
| 35' Mast Arm                                                               | 1                  | Ea.  | 3,200.00    | 3,200.00    | Construction Engineering, 10% |                    |      |           | 4,371.00    |
| 3. Pedestrian heads                                                        | 8                  | Ea.  | 190.00      | 1,572.00    | GRAND TOTAL                   |                    |      |           | \$48,080.00 |
| 4. Conduit and wire                                                        | 265                | L.F. | 6.00        | 1,590.00    |                               |                    |      |           |             |
| 5. Junction boxes                                                          | 4                  | Ea.  | 65.00       | 260.00      |                               |                    |      |           |             |
| 6. Inductive loops                                                         | 4                  | Ea.  | 250.00      | 1,000.00    |                               |                    |      |           |             |
| 7. Concrete island                                                         | 21                 | C.Y. | 75.00       | 1,575.00    |                               |                    |      |           |             |
| 8. Street excavation                                                       | 514                | C.Y. | 3.00        | 1,542.00    |                               |                    |      |           |             |
| 9. Roadway construction                                                    | 1,541              | S.Y. | 6.00        | 9,246.00    |                               |                    |      |           |             |
| 10. Concrete curb and gutter                                               | 800                | L.F. | 7.00        | 5,600.00    |                               |                    |      |           |             |
| 11. Type B curb                                                            | 500                | L.F. | 3.00        | 1,500.00    |                               |                    |      |           |             |
| 12. Street striping and signing                                            | 1                  | L.S. | 400.00      | 400.00      |                               |                    |      |           |             |
| 13. Relocate catch basin                                                   | 1                  | Ea.  | 250.00      | 250.00      |                               |                    |      |           |             |



Traffic Signals & Street Improvements  
Knowles Street, Stephens Ave. & Mount Ave.





Russell Street at Kent Avenue

## INTRODUCTION

Kent Avenue provides access between Russell Street and the shopping center parking lot southeast of the intersection. Russell Street carries 11,300 vehicles per day at this location. Six accidents were reported for 1970-1971, although five of the accidents occurred in 1970. Present traffic control is via stop-signs on Kent Avenue.

## SCOPE OF WORK

Painted left-turn channelization is recommended on Russell Street and the east approach of Kent Avenue. Increased corner radii are also indicated for the east leg of Kent Avenue. Additional right-of-way is not required.

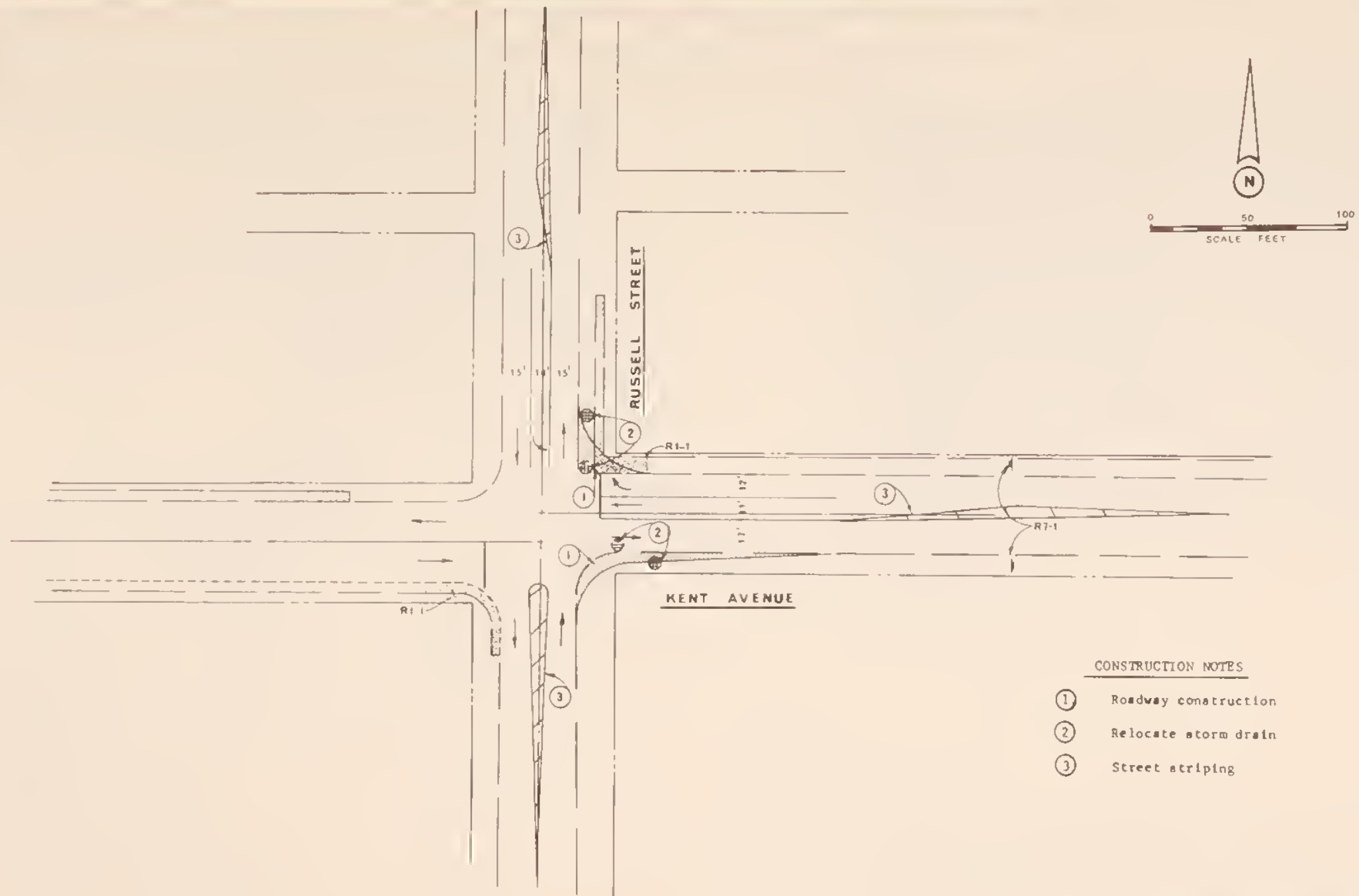
## JUSTIFICATION

The provision of two approach lanes on the east leg of Kent Avenue will reduce current delays to traffic. With the implementation of the access control improvements on Brooks Street, the turning traffic between the north leg of Russell Street and east leg of Kent Street will increase, further warranting the proposed improvements. Increased corner radii will facilitate truck turning movements.

## RUSSELL AVENUE AND KENT AVENUE

### COST ESTIMATE

| <u>Description</u>            | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u>  |
|-------------------------------|-------------------------------|-------------|------------------|--------------------|
| 1. Street excavation          | 27                            | C.Y.        | \$ 3.00          | \$ 81.00           |
| 2. Roadway construction       | 81                            | S.Y.        | 6.00             | 486.00             |
| 3. Relocate storm drain       | 2                             | Ea.         | 250.00           | 500.00             |
| 4. Street striping            | 1                             | L.S.        | 200.00           | <u>200.00</u>      |
| Sub Total                     |                               |             |                  | \$ 1,267.00        |
| Contingencies, 10%            |                               |             |                  | 127.00             |
|                               |                               |             |                  | <u>\$ 1,394.00</u> |
| Construction Engineering, 10% |                               |             |                  | <u>139.00</u>      |
| GRAND TOTAL                   |                               |             |                  | <u>\$ 1,533.00</u> |



# Street Improvements Russell Street & Kent Avenue

INTRODUCTION

Russell Street carries an AADT of approximately 11,000 at this location while Strand Street is lightly traveled. Seven accidents were reported here for 1970-71. Strand Avenue is under stop-sign control and is planned to be eventually extended west of the intersection.

SCOPE OF WORK

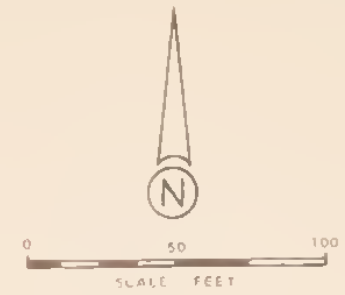
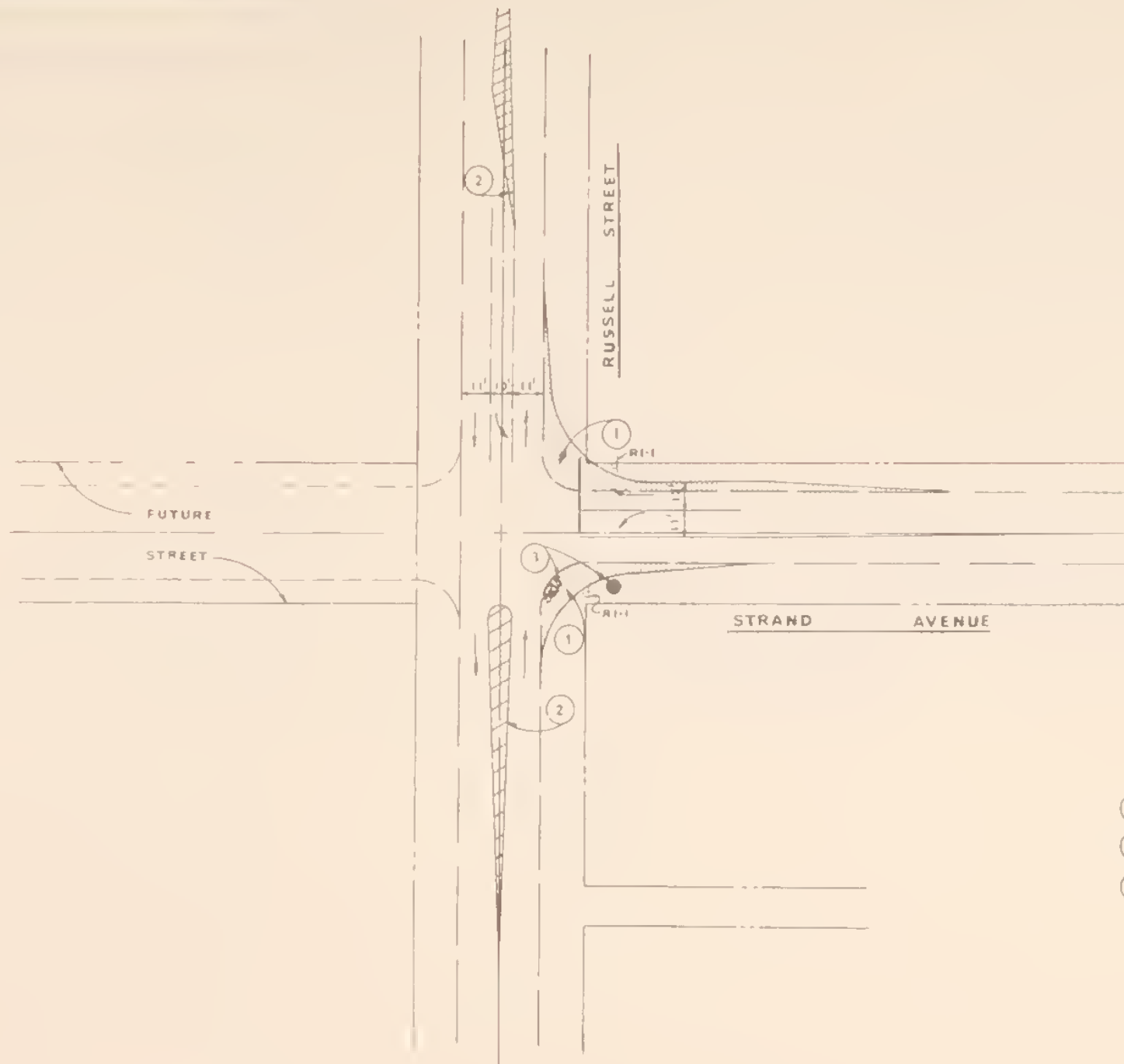
Minor widening to provide two approach lanes on Strand Avenue is proposed along with increased corner radii. Painted left-turn lane channelization is recommended for Russell Street. Additional right-of-way is not required.

JUSTIFICATION

The proposed improvements should help to alleviate the accident problem at this location which is primarily characterized by rear-end collisions on both streets and will also reduce unnecessary traffic delays. Strand Avenue is a TOPICS Type II street and will be promoted as a connector between Russell and Brooks Streets resulting in increased turning traffic between the north and east legs of the intersection. The proposed improvements should permit deferral of signalization of this location for some time.

COST ESTIMATE

| <u>Description</u>            |                      | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|-------------------------------|----------------------|-------------------------------|-------------|------------------|-------------------|
| 1.                            | Street excavation    | 71                            | C.Y.        | \$ 3.00          | \$ 213.00         |
| 2.                            | Roadway construction | 213                           | S.Y.        | 6.00             | 1,278.00          |
| 3.                            | Relocate storm drain | 1                             | Ea.         | 250.00           | 250.00            |
| 4.                            | Street striping      | 1                             | L.S.        | 200.00           | 200.00            |
| Sub Total                     |                      |                               |             |                  | \$ 1,941.00       |
| Contingencies, 10%            |                      |                               |             |                  | 194.00            |
|                               |                      |                               |             |                  | \$ 2,135.00       |
| Construction Engineering, 10% |                      |                               |             |                  | 214.00            |
| GRAND TOTAL                   |                      |                               |             |                  | \$ 2,349.00       |



CONSTRUCTION NOTES

- ① Roadway construction
- ② Street striping
- ③ Abandon existing rock drain and install new storm drain

Street Improvements  
Russell St. & Strand Ave.

## TOPICS IMPROVEMENT PROJECT

### Russell Street at 39th Street

#### INTRODUCTION

Russell Street is one of the city's three major north-south through streets and at the present time has an AADT of 6,600 vehicles at S. 39th Street. Thirty-ninth Street is the most southerly through east-west street and carries an AADT of 7,800 vehicles. Approximately 200 feet to the west of this intersection is a signalized school pedestrian crossing utilized by children living south of 39th Street in the Wapikiya subdivision and going to the Charles Russell School approximately 0.38 miles to the north on Russell Street. Motorists' observance of the pedestrian signal is poor.

#### JUSTIFICATION

The need for more effective school pedestrian crossing signalization warrants relocation of the crossing to the subject intersection thus requiring vehicular signal control. The proposed roadway widenings will help to reduce delay and improve vehicular safety and will help to accommodate increased turning traffic which will result from a proposed collector street which is to intersect 39th Street 680' to the east of the intersection.

Current traffic volumes satisfy Warrant No. 1 (See Signal Warrant Sheet) for signal control for 7 hours of the required 8 hours. For the 8th hour the traffic volume on the major street (39th Street) is satisfied to the extent of 90% of the required value. The intersection does satisfy Warrant No. 7.

#### SCOPE OF WORK

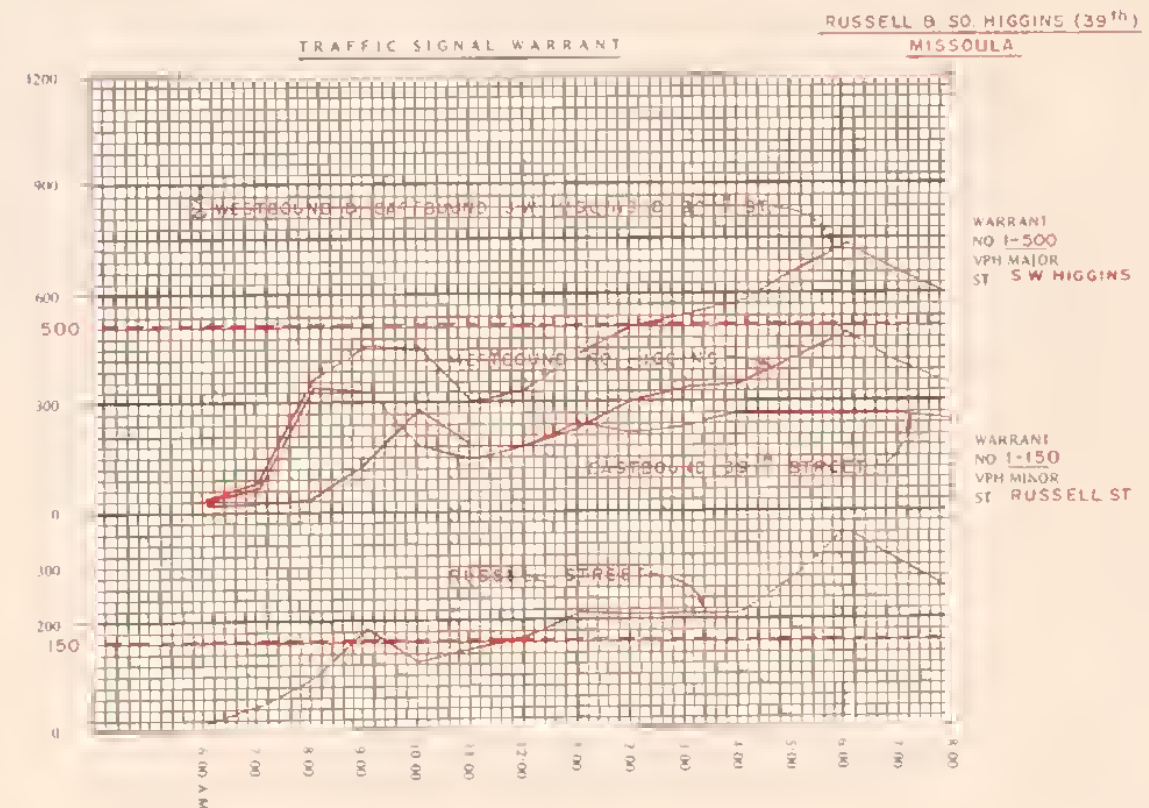
It is proposed that a new two-phase (expansible to three-phase) full-actuated traffic signal be installed, complete with pedestrian signals and pedestrian push buttons. When the new traffic signal is operational the existing school crossing signals shall be removed and salvaged.

Russell Street is to be widened to provide separate lanes for left and right turning traffic. Increased corner radii with curbs set to provide for future widening of both streets are also recommended. Minor widening is proposed on 39th Street to provide for a separate left-turn lane to Russell Street. On the basis of traffic projections, the ultimate design width utilized for pole setbacks and curb and gutter returns is 59' on 39th Street for one left-turn lane and four through lanes and is 48' on Russell Street for one left-turn and right-turn lane southbound and two through lanes northbound.

However, if the city stipulates that the collector road for the proposed large development to the south of S. 39th Street is to intersect at this location to form a standard cross intersection, the ultimate design width on Russell Street should be increased to a minimum of 59 feet, and all signal appurtenances should be located accordingly, and the controller should be expandible to a five-phase operation.

A five-foot asphalt concrete walkway is to be constructed eastward along the south side of 39th Street from the existing school crossing to Russell Street and thence north along the east side of Russell Street to the Russell school, for a total of 0.43 miles of new walkway construction.

The widening and walkways as indicated on the Improvement Diagram are desirable, but not absolutely necessary. The signal installation with all mast arm poles and signal appurtenances located for the ultimate cross-sections could be constructed by itself for approximately \$23,000.





# RUSSELL STREET AND 39TH STREET

## COST ESTIMATE

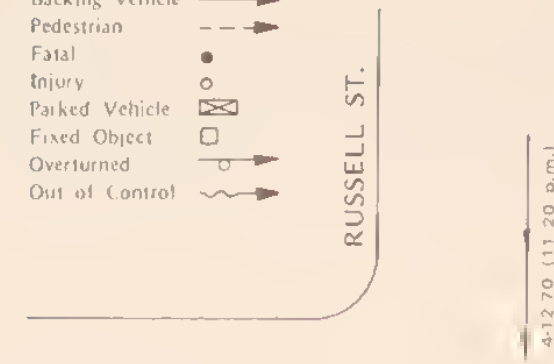
| Description                                                            | Estimated Quantity | Unit     | Unit Cost  | Total Cost  |
|------------------------------------------------------------------------|--------------------|----------|------------|-------------|
| 1. Install 3 phase full actuated controller in Type D cabinet complete | 1                  | L.S.     | L.S.       | \$ 6,500.00 |
| 2. Traffic signal pole, 25' M.A.                                       | 1                  | Ea.      | \$2,200.00 | 2,200.00    |
| Traffic signal pole, 2-25' M.A.                                        | 1                  | Ea.      | 3,200.00   | 3,200.00    |
| 3. Conduit 2"                                                          | 230                | L.F.     | 10.00      | 2,300.00    |
| Conduit 2½"                                                            | 20                 | L.F.     | 11.00      | 220.00      |
| Conduit 1½"                                                            | 420                | L.F.     | 6.00       | 2,520.00    |
| 4. Pullboxes                                                           | 7                  | Ea.      | 80.00      | 560.00      |
| 5. Inductive loops                                                     | 6                  | Ea.      | 250.00     | 1,500.00    |
| 6. Remove pedestrian signals and salvage                               | 1                  | L.S.     | 300.00     | 300.00      |
| 7. Construct 5' A/C walkway                                            | 1,270              | Sq. Yds. | 3.00       | 3,810.00    |
| 8. Striping and signing                                                | 1                  | L.S.     | 300.00     | 300.00      |
| 9. Street excavation                                                   | 245                | C.Y.     | 3.00       | 735.00      |
| 10. Roadway construction                                               | 736                | S.Y.     | 6.00       | 4,416.00    |
| Sub Total                                                              |                    |          |            | \$28,561.00 |
| Contingencies, 10%                                                     |                    |          |            | 2,856.00    |
|                                                                        |                    |          |            | \$31,417.00 |
| Construction Engineering, 10%                                          |                    |          |            | 3,142.00    |
| GRAND TOTAL                                                            |                    |          |            | \$34,559.00 |

## COLLISION DIAGRAM

CITY OF MISSOULA  
1970 & 1972

## LEGEND - SYMBOLS

Moving Vehicle →  
Backing Vehicle →  
Pedestrian - - - →  
Fatal •  
Injury ○  
Parked Vehicle ☒  
Fixed Object □  
Overturned ○→  
Out of Control ~→



LOCATION RUSSELL & 39TH

39TH ST.

## LEGEND

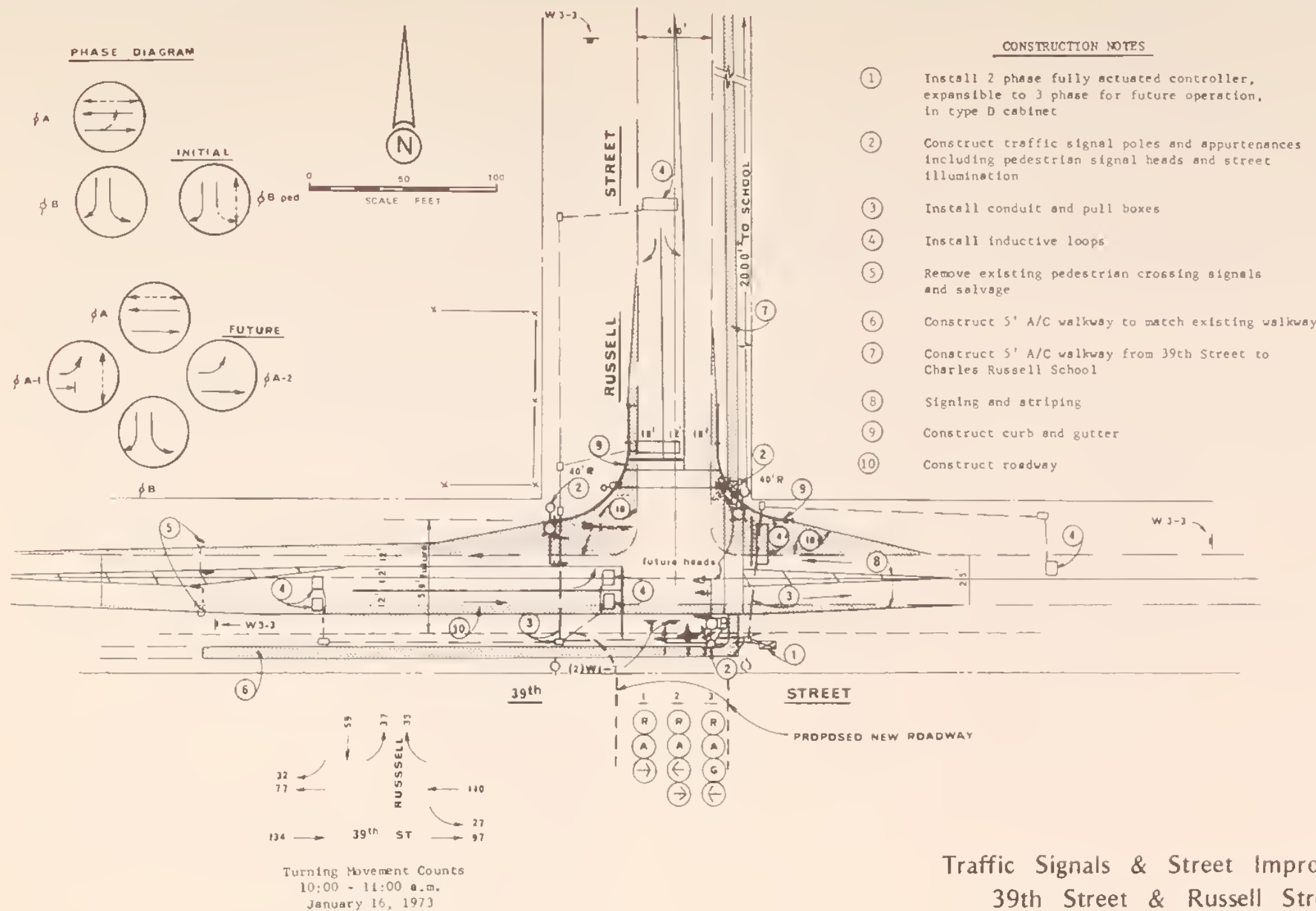
Time \_\_\_\_ A=A.M. P=P.M.  
Pavement - D=Dry W=Wet I=Icy  
Weather - C=Clear F=Fog  
R=Rain SL=Sleet  
S=Snow

## PROBABLE CAUSE

Exceeding Safe speed (ESS)  
Exceeding Speed limit (ESL)  
Ran Stop sign (RSS)  
Ran Signal (RS)  
Stopped, then proceeded (S&P)  
Following too close (FTC)  
Wrong side of road (WSR)  
Violated right of way (V/RW)  
Had been drinking (HBD)  
Did not see traffic (NSTC)  
Control Device  
Driving attention diverted (DAD)  
Mechanical Failure (MF)

## ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |



Traffic Signals & Street Improvements  
39th Street & Russell Street

## TOPICS IMPROVEMENT PROJECT

### Russell Street at 11th Street/Knowles Street and Ronan Street

#### INTRODUCTION

Russell Street is the major through north-south route for the westerly section of the city and has an AADT of 12,000 vehicles at this location. Knowles Street provides an alternate route to gain access to the commercial development on Brooks Avenue, and leads via Mount Avenue and Stephens Avenue to the southeast portion of the city. Nine accidents were reported for this location for 1970-71, seven of which were at the 11th/Knowles and Russell Street intersection.

#### JUSTIFICATION

The proposed improvement will facilitate the left-turn movement from Russell Street to Knowles Street, which amounts to 60 vehicles per hour during off-peak periods. Delay to southbound through traffic on Russell Street will be reduced. Closure of Ronan Street will reduce the potential hazard for head-on and right-angle accidents and improve the orderliness of traffic flow through the area.

#### SCOPE OF WORK

Widen Russell Street to provide a left-turn lane for southbound traffic, and closed Ronan Street between Russell Street and Knowles Street. The widening on Russell Street is to be accomplished on one side only; the curb and gutter are set for an ultimate design width of 58' on Russell Street in order to provide one left-turn lane and four through lanes.

#### LEGEND - SYMBOLS

|                 |    |
|-----------------|----|
| Moving Vehicle  | →  |
| Backing Vehicle | ←  |
| Pedestrian      | →  |
| Fatal           | ●  |
| Injury          | ○  |
| Parked Vehicle  | ⊠  |
| Fixed Object    | □  |
| Overturned      | ↺  |
| Out of Control  | ~→ |

#### LEGEND

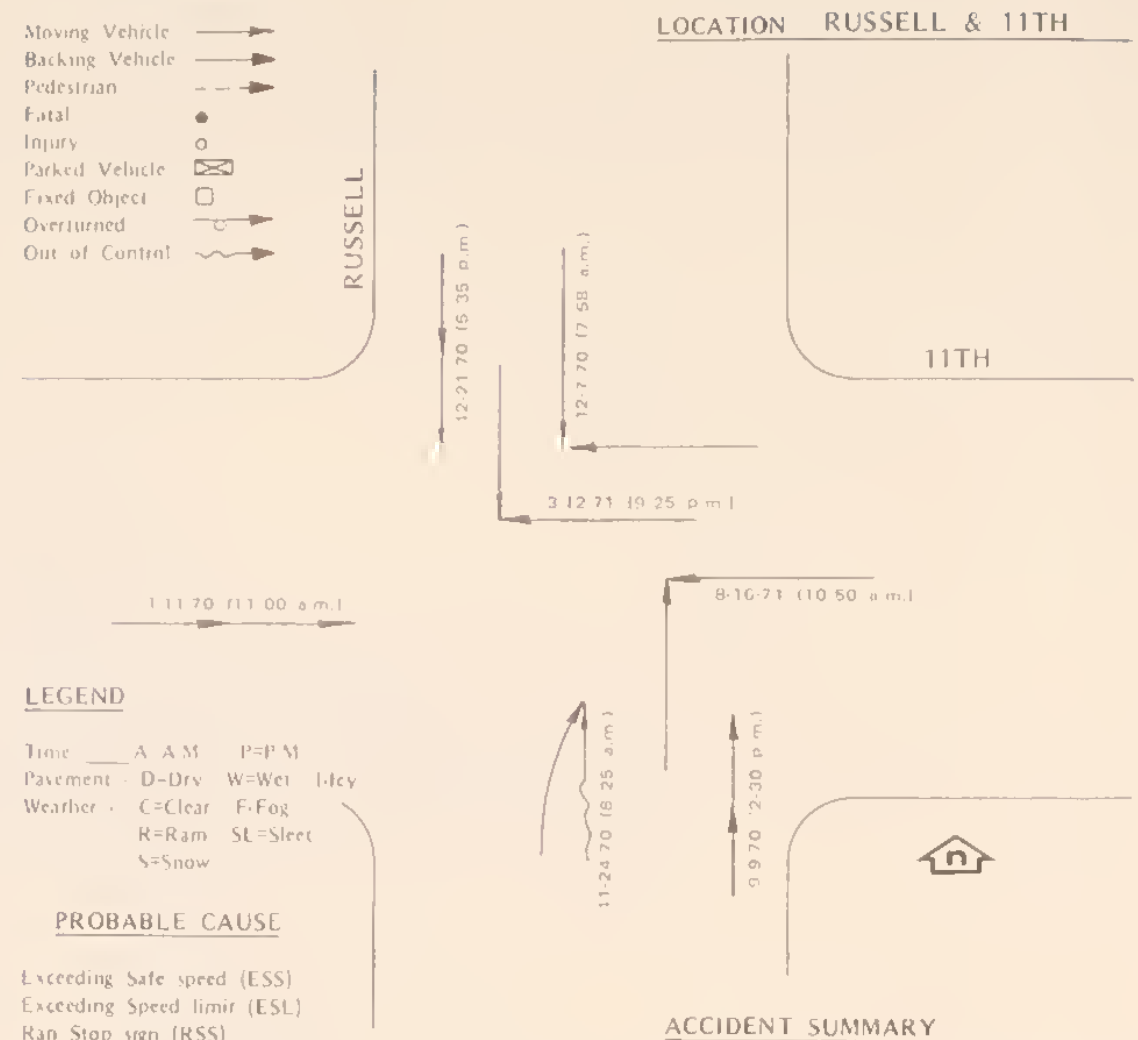
|          |       |   |   |   |   |   |   |   |   |   |   |   |   |
|----------|-------|---|---|---|---|---|---|---|---|---|---|---|---|
| Time     | _____ | A | A | M | P | P | M |   |   |   |   |   |   |
| Pavement |       | D | - | D | W | - | W | I | - | I |   |   |   |
| Weather  |       | C | - | C | F | - | F | R | - | R | S | - | S |
|          |       | R | - | R | S | - | S | S | - | S | S | - | S |
|          |       | S | - | S | S | - | S | S | - | S | S | - | S |

#### PROBABLE CAUSE

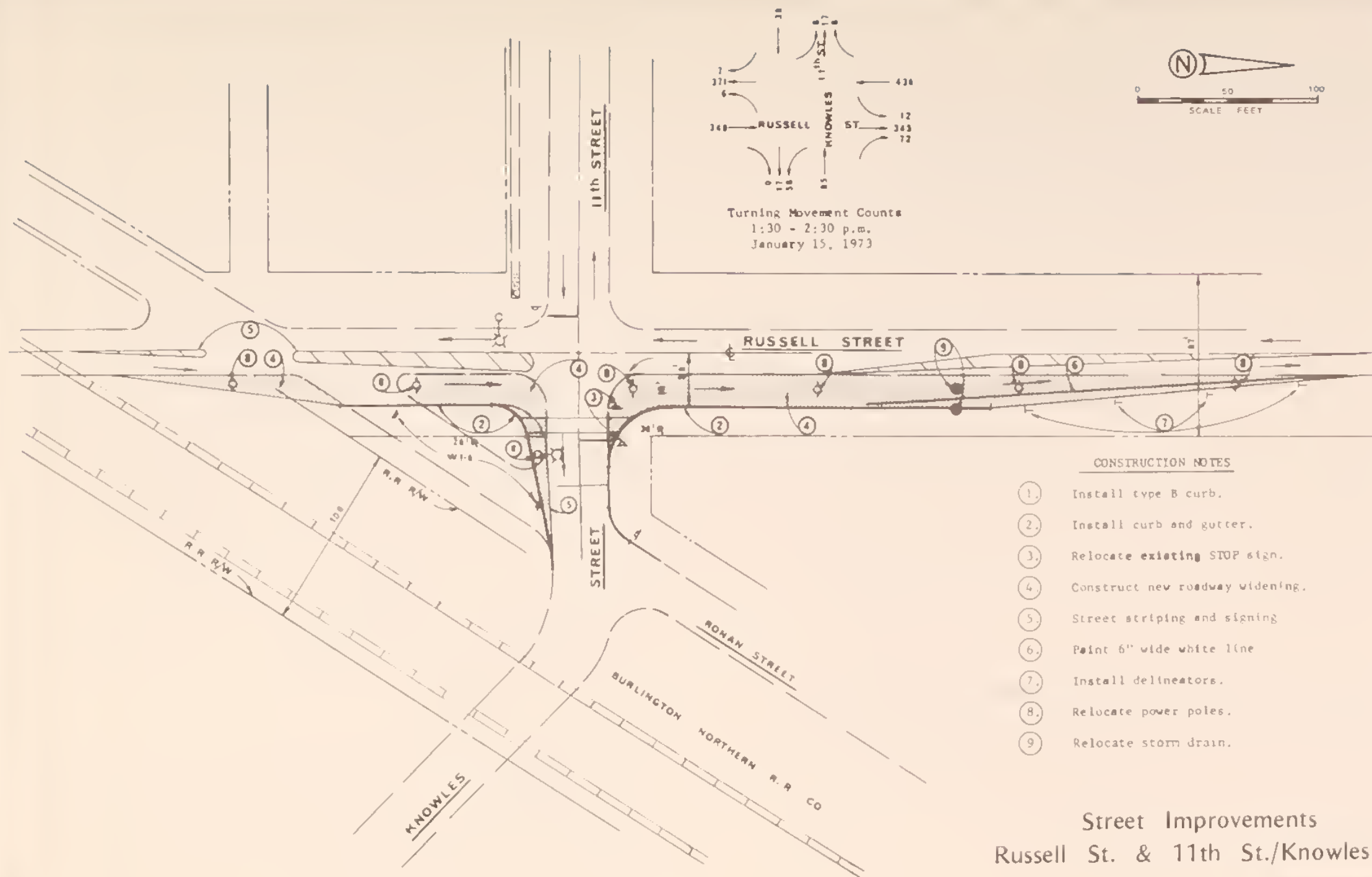
- Exceeding Safe speed (ESS)
- Exceeding Speed limit (ESL)
- Ran Stop sign (RSS)
- Ran Signal (RS)
- Stopped, then proceeded (S&P)
- Following too close (FTC)
- Wrong side of road (WSR)
- Violated right of way (V/RW)
- Had been drinking (HBD)
- Did not see traffic (NSTC)
- Control Device
- Driving attention diverted (DAD)
- Mechanical Failure (MF)

#### COLLISION DIAGRAM

CITY OF MISSOULA  
1970 to 1971



| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |



RUSSELL STREET & 11TH STREET/KNOWLES STREET

COST ESTIMATE

|    | <u>Description</u>                                     | <u>Estimated<br/>Quantity</u> | <u>Unit</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|----|--------------------------------------------------------|-------------------------------|-------------|------------------|-------------------|
| 1. | Roadway excavation                                     | 638                           | C.Y.        | \$ 2.00          | \$ 1,276.00       |
| 2. | Roadway construction                                   | 471                           | S.Y.        | 6.00             | 2,826.00          |
| 3. | Curb and gutter                                        | 335                           | L.F.        | 7.50             | 2,513.00          |
| 4. | Type B curbing                                         | 65                            | L.F.        | 3.00             | 195.00            |
| 5. | Relocate power poles                                   | 6                             | Ea.         | 200.00           | 1,200.00          |
| 6. | Street striping and signing<br>(including delineators) | 1                             | L.S.        | 300.00           | 300.00            |
| 7. | Relocate Existing Storm Drain                          | 1                             | L.S.        | 300.00           | <u>300.00</u>     |
|    | Sub Total                                              |                               |             |                  | \$ 8,610.00       |
|    | Contingencies, 10%                                     |                               |             |                  | 861.00            |
|    |                                                        |                               |             |                  | \$ 9,471.00       |
|    | Construction Engineering, 10%                          |                               |             |                  | <u>947.00</u>     |
|    | GRAND TOTAL                                            |                               |             |                  | \$10,418.00       |



## TOPICS IMPROVEMENT PROJECT

### Russell Street and South 3rd Street

#### Russell Street and Broadway

## INTRODUCTION

Russell Street is the only north-south arterial street on the west side of the city which connects Broadway to the south end of the city via a two-lane bridge over the Clark Fork River and a two-lane underpass under the Milwaukee Railroad tracks. Russell Street between Broadway and South 3rd Street is a two-lane facility with an AADT of 17,400 vehicles per day. The west approach of South 3rd Street has an AADT of 12,500 vehicles per day, and Broadway has an AADT of 20,000 vehicles per day.

From 2:00 P.M. to approximately 4:30 P.M. Russell Street traffic, both northbound and southbound, is backed up at least one (1) quarter of a mile from the 3rd Street intersection and the Broadway intersection, and vehicles typically require 5 to 10 minutes to clear the respective intersections. During the P.M. peak (4:30 P.M. to 5:30 P.M.) the backup of traffic extends to greater than a half mile, and delays exceed 15 minutes. This 0.8 mile section of Russell Street with an average travel speed of 3 to 4 mph is the worst segment of arterial street in the city in terms of total vehicle delay. Excessive delays of 2 and 3 cycle lengths also occur on the west leg and WB or SB left-turn at Broadway and the west leg of South 3rd Street.

The Russell Street and Broadway intersection is ranked eighth in the city for total accidents with 23 for two-year period 1970-71. However, with the heavy traffic volumes accommodated, it ranks only 23rd on an accident rate basis. The Russell Street and 3rd Street intersection is ranked ninth for total accidents with 21 and is ranked fifteenth by accident rate.

## ANALYSIS

One of the primary purposes of the Reserve Street project between I-90 and Brooks Street is to provide traffic relief to Russell Street by diverting traffic from the southwest area of the city from the 3rd Street-Russell Street-Broadway route. Since Reserve Street is scheduled for completion within the next five years, an analysis was conducted to determine the impact of that facility on Russell Street in order to determine if short range projects would not be necessary following Reserve Street completion, and if the impact is not significant, what improvements should be accomplished under the TOPICS program to

alleviate the traffic congestion. Since the 1985 assigned volumes in the Transportation Study as compared to the present volumes on arterial streets on the west side of the city are low and do not seem to fit the present growth and circulation pattern, a license plate origin and destination study was undertaken in August of 1972 for two hours in the P.M. peak. Movements recorded were: EB on Broadway to SB on Russell Street, WB on Broadway to SB on Russell, NB on Russell to WB Broadway, SB on Russell to WB on 3rd Street, SB through and left on Russell at 3rd Street, and EB on 3rd Street to NB on Russell Street. The results are summarized in both tabular and pictorial form.

Based solely on this study the opening of Reserve Street will only decrease volumes on Russell Street by 15 to 20% and will decrease the EB Broadway to SB Russell Street movement by 15 to 25% and the EB 3rd Street to NB Russell movement by 25 to 35%. In other words, the predominant desire line is from South 3rd Street and Russell Street to a destination east of the Broadway-Russell Street intersection.

Even with the Reserve Street project constructed, Russell Street must still be widened to four-lanes in order to successfully accommodate the traffic flows and desires - a major project outside the scope of the TOPICS program especially with the two large structures.

Therefore, the analysis was confined to the two end intersections to determine means of reducing the total cycle time of the signals, of producing a green time to cycle time ratio more favorable to the Russell Street approaches, and of providing a greater capacity by widening certain approach lanes without increasing the accident potential.

Even though these two intersection improvements are included in this one project report, it is not essential that they be constructed during the same time period.

### SCOPE OF WORK: Russell Street and South 3rd Street

The improvement at this intersection is compounded by an irrigation box culvert running diagonally across the intersection from the NE quadrant to the SW quadrant. The box culvert is presently constructed such that, if any widening is to be accomplished on either leg of South 3rd Street and on the north leg of Russell Street, the culvert must be lengthened in order to accommodate an embankment. Consequently, it was decided that, since a structure is involved, the ultimate cross-section for South 3rd Street and the east side of the north leg of Russell Street should be constructed if widening became necessary.

Based upon the license O & D, projected traffic from present day travel trends, and the traffic assignment in the transportation study, a 60 foot cross-section was selected on the west leg of South 3rd Street which will ultimately provide one EB through lane,

# RUSSELL STREET AND SOUTH 3RD STREET

## COST ESTIMATE

|     | Description                                                                                                                    | Estimated<br>Quantity | Unit     | Unit Cost   | Total Cost  |
|-----|--------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------|-------------|-------------|
| 1.  | Rewire existing Type III SS controller in new Type D pedestal cabinet, complete in place. Including new service & interconnect | 1                     | L.S.     | \$ 2,000.00 | \$ 2,000.00 |
| 2.  | Traffic signal pole luminaire arms complete, installed                                                                         | 2                     | Ea.      | 350.00      | 700.00      |
| 3.  | Traffic signal pole, w/luminaire (Use existing signal & ped. heads)<br>Install PVII for left turn movement                     |                       |          |             |             |
|     | 20' Mast Arm                                                                                                                   | 1                     | Ea.      | 1,800.00    | 1,800.00    |
|     | 30' Mast Arm                                                                                                                   | 1                     | Ea.      | 2,000.00    | 2,000.00    |
| 4.  | Conduit                                                                                                                        | 175                   | L.F.     | 5.00        | 875.00      |
| 5.  | Traffic signal wire                                                                                                            | 350                   | L.F.     | 2.00        | 700.00      |
| 6.  | Inductive loop detectors                                                                                                       | 10                    | Ea.      | 250.00      | 2,500.00    |
| 7.  | Roadway excavation                                                                                                             | 567                   | Cu. Yds. | 2.00        | 1,134.00    |
| 8.  | Roadway construction                                                                                                           | 3,477                 | Sq. Yds. | 6.00        | 20,862.00   |
| 9.  | Embankment construction                                                                                                        | 2,061                 | Cu. Yds. | 5.00        | 10,305.00   |
| 10. | Guardrail installation                                                                                                         | 100                   | L.F.     | 7.50        | 750.00      |
| 11. | Street lighting poles                                                                                                          | 3                     | Ea.      | 900.00      | 2,700.00    |
| 12. | Conduit                                                                                                                        | 120                   | L.F.     | 5.00        | 600.00      |
| 13. | Box culvert construction                                                                                                       | 1                     | L.S.     | 32,000.00   | 32,000.00   |
|     | Sub Total                                                                                                                      |                       |          |             | \$78,926.00 |
|     | Contingencies, 10%                                                                                                             |                       |          |             | 7,893.00    |
|     |                                                                                                                                |                       |          |             | \$86,819.00 |
|     | Construction Engineering, 10%                                                                                                  |                       |          |             | 8,682.00    |
|     | GRAND TOTAL                                                                                                                    |                       |          |             | \$95,501.00 |

two left-turn lanes, and two WB through lanes (one through lane from the east approach of South 3rd Street and one right-turn movement from Russell Street). The proposed widening is offset from the right-of-way centerline. South 3rd Street is designed for a 45' width at the intersection which will transition to a 40' basic roadway width. Four approach lanes and two wide exit lanes to accommodate the double left-turn are provided on the North leg of Russell Street producing an approach width of 77'. Russell Street to the south is 58' wide which is the basic cross-section proposed for the street between Broadway and Brooks Street.

The initial lane configuration is shown on the improvement diagram. The widening on the south leg of Russell Street is carried to South 4th Street to meet the proposed temporary 40' cross-section from South 4th Street to 6th Street. The widening on the northwest quadrant as shown on the Improvement Diagram is not mandatory at this time on this project, but is desirable in order to expedite the right-turn movement. The widened segment on the east side of Russell Street could be shortened, but is designed to accommodate the double left-turn movement from South 3rd Street at this time by providing an appropriate length to merge into one-lane.

The reconstructed traffic signals will provide three-phase control (expandable to five-phases in the future) with a separate phase to accommodate the left-turn on the west approach of South 3rd Street. New street lighting is provided, and the concrete box culvert is lengthened.

SCOPE OF WORK: Broadway and Russell Street

It is proposed that the south approach of Russell Street be widened to provide a three-lane approach; a left-turn lane; an optional left-through lane, and a right-turn lane as shown on the Improvement Diagram. In addition, a new full-actuated four-phase with two overlaps signal control is recommended. The north and south approaches of Russell Street will proceed on separate phases. A new mast arm will provide improved signal visibility for the south approach of Russell Street, and span-wire mounted lane control signing is also recommended for that approach. Left-turn guide striping and a minor setback of the median nose on the west leg of Broadway will facilitate the heavy dual left-turn from Russell Street.

A basically different alternative for improvement of operations at this location was also studied: prohibition of the left-turn movement on the south approach of Russell Street and rerouting that movement via the north leg of Russell Street and Birch Street or Cooper Street. This alternative would involve costly widening of the north leg of Russell Street and an east-west street and probable installation of traffic signals at the intersection of

# LICENSE PLATE ORIGIN AND DESTINATION STUDY FOR RUSSELL STREET BETWEEN BROADWAY AND 3RD STREET SOUTH

Right Turns Off Broadway for  
Southbound on Russell.

|                                        | 4 - 5 P.M.                  | Total    | 5 - 6 P.M.                   | Total    |
|----------------------------------------|-----------------------------|----------|------------------------------|----------|
| A. Making right turn on 3rd.           | 69 cars (16%)               |          | 74 cars (19%)                |          |
| B. Through and/or left turn<br>at 3rd. | 241 cars (57%)<br>310 cars* | 425 cars | 230 cars (59%)<br>304 cars** | 390 cars |

\* 115 cars unaccounted for

\*\* 86 cars unaccounted for

Left Turn Off Broadway for  
Southbound Russell.

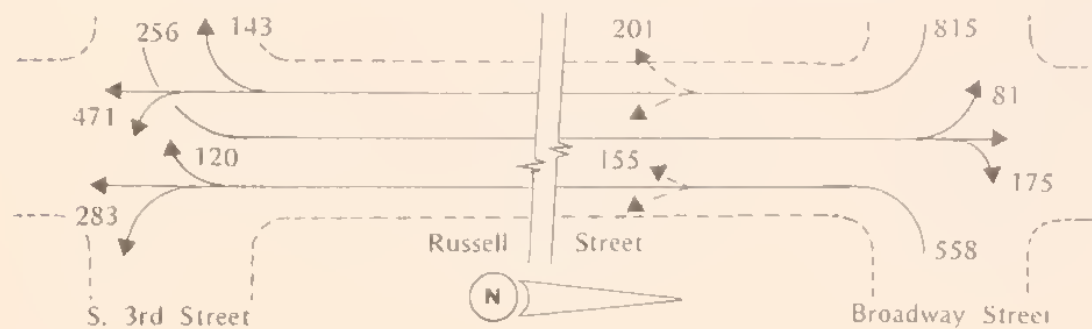
|                                        | 4 - 5 P.M.                  | Total    | 5 - 6 P.M.                   | Total    |
|----------------------------------------|-----------------------------|----------|------------------------------|----------|
| A. Making right turn on 3rd.           | 54 cars (20%)               |          | 66 cars (23%)                |          |
| B. Through and/or left turn<br>at 3rd. | 150 cars (56%)<br>204 cars* | 268 cars | 133 cars (46%)<br>199 cars** | 290 cars |

\* 64 cars unaccounted for

\*\* 91 cars unaccounted for

Left Turn on 3rd for North-  
bound Russell.

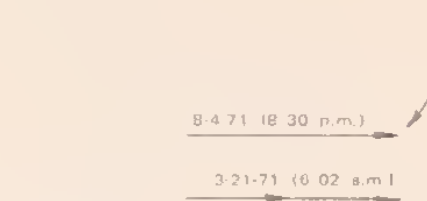
|                                             | 4 - 5 P.M.           | Total    | 5 - 6 P.M.                | Total    |
|---------------------------------------------|----------------------|----------|---------------------------|----------|
| A. Left turn on Broadway.                   | 42 cars (27%)        |          | 39 cars (38%)             |          |
| B. Through and/or right turn<br>on Broadway | 111 cars<br>153 cars | 153 cars | 64 cars (62%)<br>103 cars | 103 cars |



## COLLISION DIAGRAM CITY OF MISSOULA 1971

### LEGEND - SYMBOLS

|                 |    |
|-----------------|----|
| Moving Vehicle  | →  |
| Backing Vehicle | ←  |
| Pedestrian      | →  |
| Fatal           | ●  |
| Injury          | ○  |
| Parked Vehicle  | ⊠  |
| Fixed Object    | □  |
| Overturned      | ↺  |
| Out of Control  | ~→ |

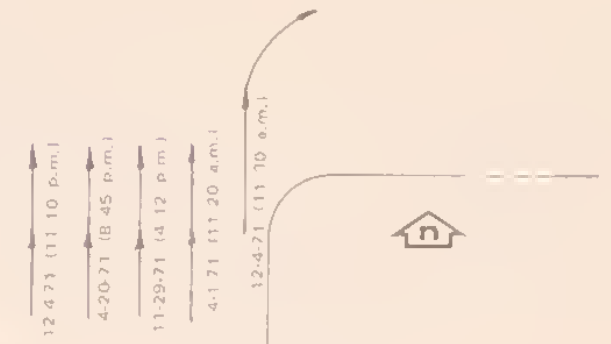


### LEGEND

|          |         |          |       |
|----------|---------|----------|-------|
| Time     | A=A.M.  | P=P.M.   |       |
| Pavement | D=Dry   | W=Wet    | I=Icy |
| Weather  | C=Clear | F=Fog    |       |
|          | R=Rain  | SL=Sleet |       |
|          | S=Snow  |          |       |

### PROBABLE CAUSE

Exceeding Safe speed (ESS)  
Exceeding Speed limit (ESL)  
Ran Stop sign (RSS)  
Ran Signal (RS)  
Stopped, then proceeded (S&P)  
Following too close (FTC)  
Wrong side of road (WSR)  
Violated right of way (V/RW)  
Had been drinking (HBD)  
Did not see traffic (NSTC)  
Control Device  
Driving attention diverted (DAD)  
Mechanical Failure (MF)



### ACCIDENT SUMMARY

| TYPE        | DAY   |     |     | NIGHT |     |     | TOTAL |     |     |
|-------------|-------|-----|-----|-------|-----|-----|-------|-----|-----|
|             | Fatal | Inj | P.D | Fatal | Inj | P.D | Fatal | Inj | P.D |
| Right Angle |       |     |     |       |     |     |       |     |     |
| Rear End    |       |     |     |       |     |     |       |     |     |
| Left Turn   |       |     |     |       |     |     |       |     |     |
| Sideswipe   |       |     |     |       |     |     |       |     |     |
| Pedestrian  |       |     |     |       |     |     |       |     |     |
| Other       |       |     |     |       |     |     |       |     |     |



PHASE DIAGRAM

φ A

φ B

φ C

Turning Movement Count  
4:00 - 5:00 p.m.  
8-15-72

ULTIMATE LANE  
CONFIGURATION



WIDENING

TAPER 25:1

CONSTRUCTION NOTES

E. Existing traffic signal poles

1. Install existing type III ss controller in new type D pedestal cabinet complete.
2. Install new traffic signal poles (using existing traffic signal heads)
3. Install street light on existing traffic signal pole.
4. Install inductive loops.
5. Existing inductive loop to remain in place and used
6. Abandon existing inductive loops.
7. Install water tight junction box.
8. Install conduit.
9. Roadway construction.
10. Construct curb and gutter.
11. Install guard rail.
12. Install new street lighting.
13. Install street striping and signing.
14. Extend existing concrete box culvert.

Traffic Signal Modification and  
Street Construction  
South 3rd Street & Russell Street



Birch Street, Mullen Road and Broadway to allow the rerouted traffic to gain access to Mullen Road. Overall net traffic benefits would be about the same as those expected from the recommended treatment.

JUSTIFICATION

While both locations have high accident rates, the primary justification for the proposed improvements are the extended periods of congestion stemming from the high traffic demand on all approaches relative to limited existing roadway capacity. The proposed widening and multi-phase signal control should substantially reduce congestion and will be consistent with likely future widening of all routes. At Russell Street and South 3rd Street, the improved signal visibility and improved capacity should reduce the current predominance of rear-end collisions.

At Russell Street and Broadway, the proposed use of a dual left-turn lane combined with the width of Broadway and past left-turn collisions between Russell Street vehicles support the separate phasing for the Russell Street approaches.

At both intersections the cycle lengths should be reduced, and a higher percentage of green time per vehicle should be achieved on the Russell Street approaches. At both intersections Warrant No. 1 and Warrant No. 2 are satisfied in that the eighth highest hour exceeds the stated values.

RUSSELL STREET AND BROADWAY  
COST ESTIMATE

|    | Description                                                 | Estimated Quantity | Unit | Unit Cost   | Total Cost   |
|----|-------------------------------------------------------------|--------------------|------|-------------|--------------|
| 1. | 4-Phase fully-actuated controller, complete in place        | 1                  | L.S. | \$12,000.00 | \$ 12,000.00 |
| 2. | Remove & salvage pedestrian heads                           | 2                  | Ea.  | 50.00       | 100.00       |
| 3. | Street excavation                                           | 60                 | C.Y. | 3.00        | 180.00       |
| 4. | Construct new curb and gutter                               | 100                | L.F. | 7.50        | 750.00       |
| 5. | Construct embankment                                        | 280                | C.Y. | 5.00        | 1,400.00     |
| 6. | Relocate guard rail                                         | 130                | L.F. | 7.50        | 975.00       |
| 7. | Construct new roadway                                       | 330                | S.Y. | 6.00        | 1,980.00     |
| 8. | Striping and signing (including overhead sign on span wire) | 1                  | L.S. | 1,300.00    | 1,300.00     |
| 9. | Traffic signal pole w/existing heads, 25' Mast Arm          | 1                  | L.S. | 1,600.00    | 1,600.00     |
|    | Sub Total                                                   |                    |      |             | \$ 20,285.00 |
|    | Contingencies, 10%                                          |                    |      |             | 2,028.00     |
|    |                                                             |                    |      |             | \$ 22,313.00 |
|    | Construction Engineering, 10%                               |                    |      |             | 2,231.00     |
|    | GRAND TOTAL                                                 |                    |      |             | \$ 24,544.00 |



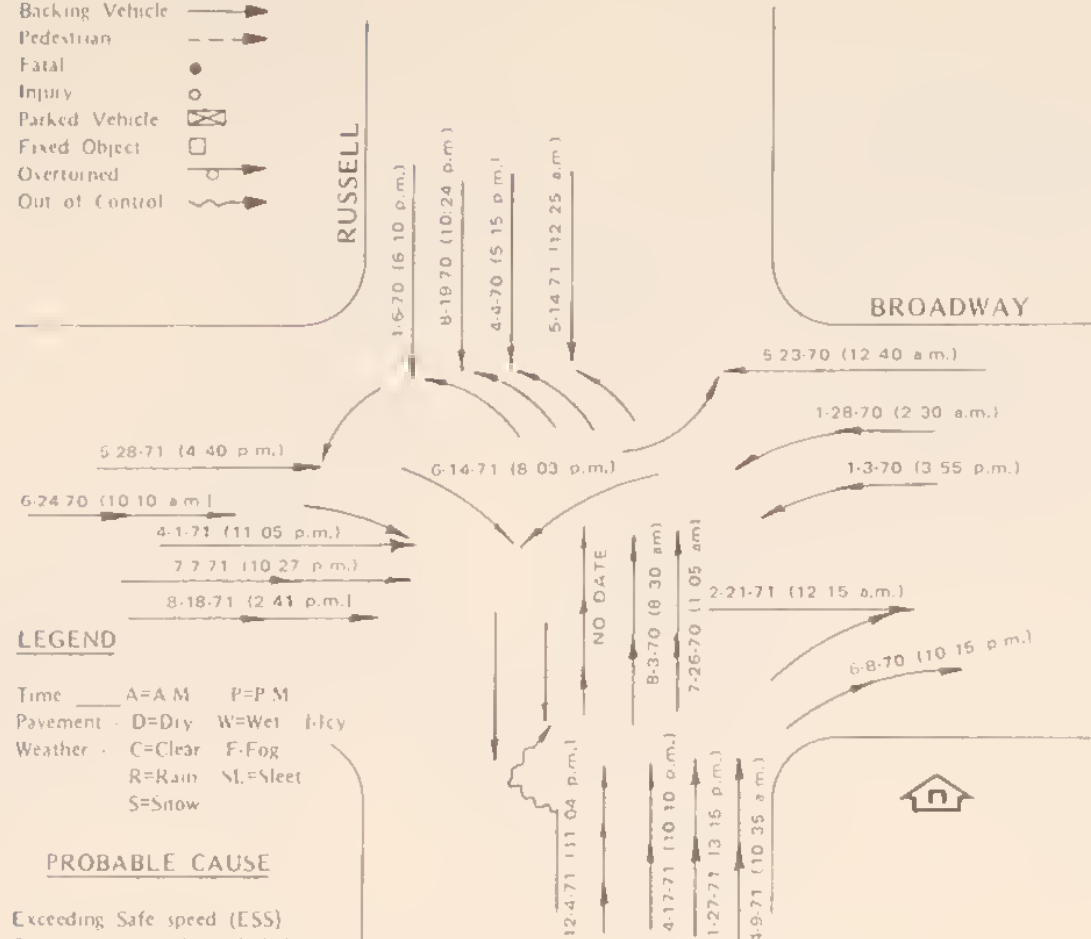
# COLLISION DIAGRAM

CITY OF MISSOULA  
1970 to 1971

## LEGEND - SYMBOLS

Moving Vehicle →  
Backing Vehicle →  
Pedestrian - - - →  
Fatal •  
Injury ○  
Parked Vehicle ☒  
Fixed Object □  
Overturned ⤵  
Out of Control ⤵

## LOCATION BROADWAY & RUSSELL



## LEGEND

Time \_\_\_\_ A=A.M. P=P.M.  
Pavement - D=Dry W=Wet I-Icy  
Weather - C=Clear F=Fog  
R=Rain SL=Sleet  
S=Snow

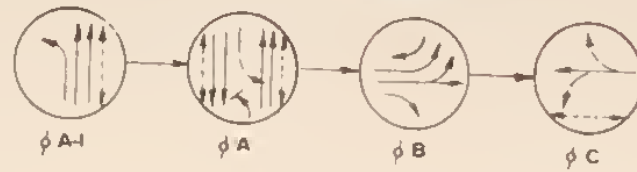
## PROBABLE CAUSE

Exceeding Safe speed (ESS)  
Exceeding Speed limit (ESL)  
Ran Stop sign (RSS)  
Ran Signal (RS)  
Stopped, then proceeded (S&P)  
Following too close (FTC)  
Wrong side of road (WSR)  
Violated right of way (V/RW)  
Had been drinking (HBD)  
Did not see traffic (NSTC)  
Control Device  
Driving attention diverted (DAD)  
Mechanical Failure (MF)

## ACCIDENT SUMMARY

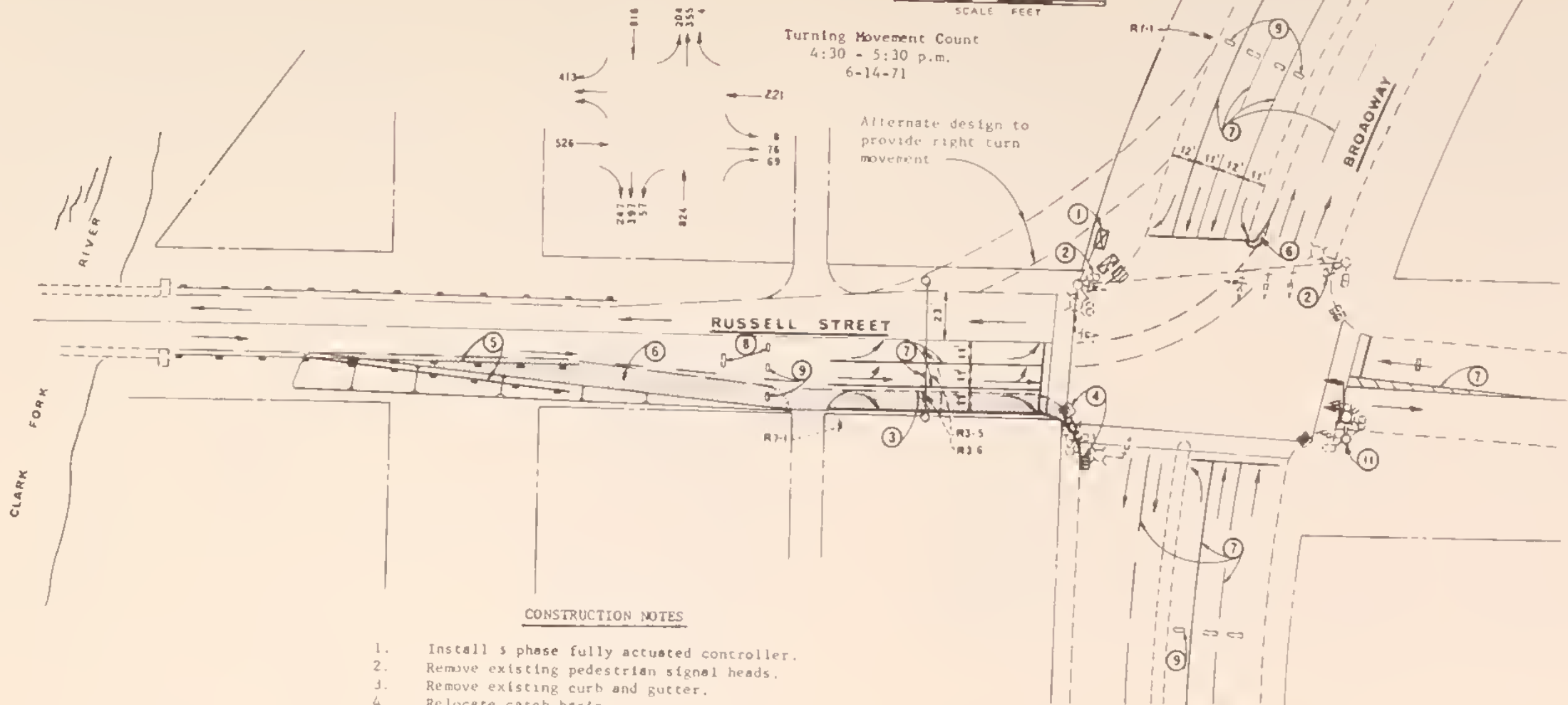
| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |

# PHASE DIAGRAM



Turning Movement Count  
4:30 - 5:30 p.m.  
6-14-71

Alternate design to  
provide right turn  
movement



## CONSTRUCTION NOTES

1. Install 5 phase fully actuated controller.
2. Remove existing pedestrian signal heads.
3. Remove existing curb and gutter.
4. Relocate catch basin.
5. Relocate guard rail.
6. Construct new roadway.
7. Signing and striping.
8. Relocate existing magnetic detectors.
9. Install new magnetic detectors.
10. Construct curb and gutter.
11. Install traffic pole with existing traffic signal heads

Street Improvements  
Broadway and Russell Street

## TOPICS IMPROVEMENT PROJECT

### Broadway at Van Buren Street

#### INTRODUCTION

Broadway is the sole east-west through street north of the Clark Fork River and provides service to the heart of the CBD. At this signalized location Broadway carries an AADT of 11,500. The north leg of Van Buren Street carries an AADT of 9,400 with most of the traffic destined for Interstate 90 - Van Buren interchange several hundred feet north of Broadway. Traffic on the low-volume south leg of Van Buren is primarily generated by a shopping center in the southeast quadrant of the intersection. As shown on the Improvement Diagram, the dominant traffic movement is the right-turn from Van Buren to westbound Broadway and the reverse left-turn movement. Ranked 15th in the city with a two-year total of 16 accidents, the intersection has a moderate accident rate in relation to the substantial traffic volumes accommodated.

#### SCOPE OF WORK

It is recommended that parking be prohibited on the west leg of Broadway and the approach striped for three-lanes: left-turn, optional left-through, and through-right. Signal lens changes in the west approach signals and the installation of an additional signal in the Broadway median island will provide positive guidance for that approach. Minor widening enables provision of a separate left-turn lane on the south approach of Van Buren Street, and installation of curbing along this approach will reduce hazard and disruption to traffic flow caused by movements to and from the shopping center. A new signal located in the Van Buren Street median island will greatly improve signal visibility for this approach. The Van Buren Street median nose is to be cut back slightly to facilitate the dual left-turn onto the northbound roadway. With parking prohibitions also recommended on Broadway at Madison Street, it is recommended that curb parking be prohibited along the entire three block section of Broadway between these two locations.

#### JUSTIFICATION

While the proposed improvements will provide little improvement to the theoretical volume to capacity ratio at this location (currently 0.35 and 0.32 as improved), the overall orderliness and safety of traffic flow will be improved, and less delay will be encountered during seasons when traffic, particularly the heavy turning movement in the northwest quadrant, is significantly greater than that shown. The intersection traffic volumes as shown on the Improvement Diagram meet Warrant No. 7 for signalization. The proposed parking

prohibition will effect few abutters, since commercial establishments with off-street parking characterize this location.

### BROADWAY AND VAN BUREN STREET

#### COST ESTIMATE

|    | Description                              | Estimated Quantity | Unit | Unit Cost   | Total Cost  |
|----|------------------------------------------|--------------------|------|-------------|-------------|
| 1. | Traffic signal poles complete            | 1                  | Ea.  | \$ 2,500.00 | \$ 2,500.00 |
|    | 25' Mast Arm                             | 2                  | Ea.  | 400.00      | 800.00      |
| 2. | Conduit and wiring                       | 110                | L.F. | 6.00        | 660.00      |
| 3. | Junction boxes                           | 2                  | Ea.  | 65.00       | 130.00      |
| 4. | Remove and salvage existing street light | 1                  | Ea.  | 200.00      | 200.00      |
| 5. | Street excavation                        | 44                 | C.Y. | 3.00        | 132.00      |
| 6. | Roadway construction                     | 133                | S.Y. | 6.00        | 798.00      |
| 7. | Relocate existing storm drains           | 2                  | Ea.  | 250.00      | 500.00      |
| 8. | Street striping and signing              | 1                  | L.S. | 500.00      | 500.00      |
| 9. | Curb and gutter                          | 210                | L.F. | 7.00        | 1,470.00    |
|    | Sub Total                                |                    |      |             | \$ 7,690.00 |
|    | Contingencies, 10%                       |                    |      |             | 769.00      |
|    |                                          |                    |      |             | \$8,459.00  |
|    | Construction Engineering, 10%            |                    |      |             | 846.00      |
|    | GRAND TOTAL                              |                    |      |             | \$9,305.00  |



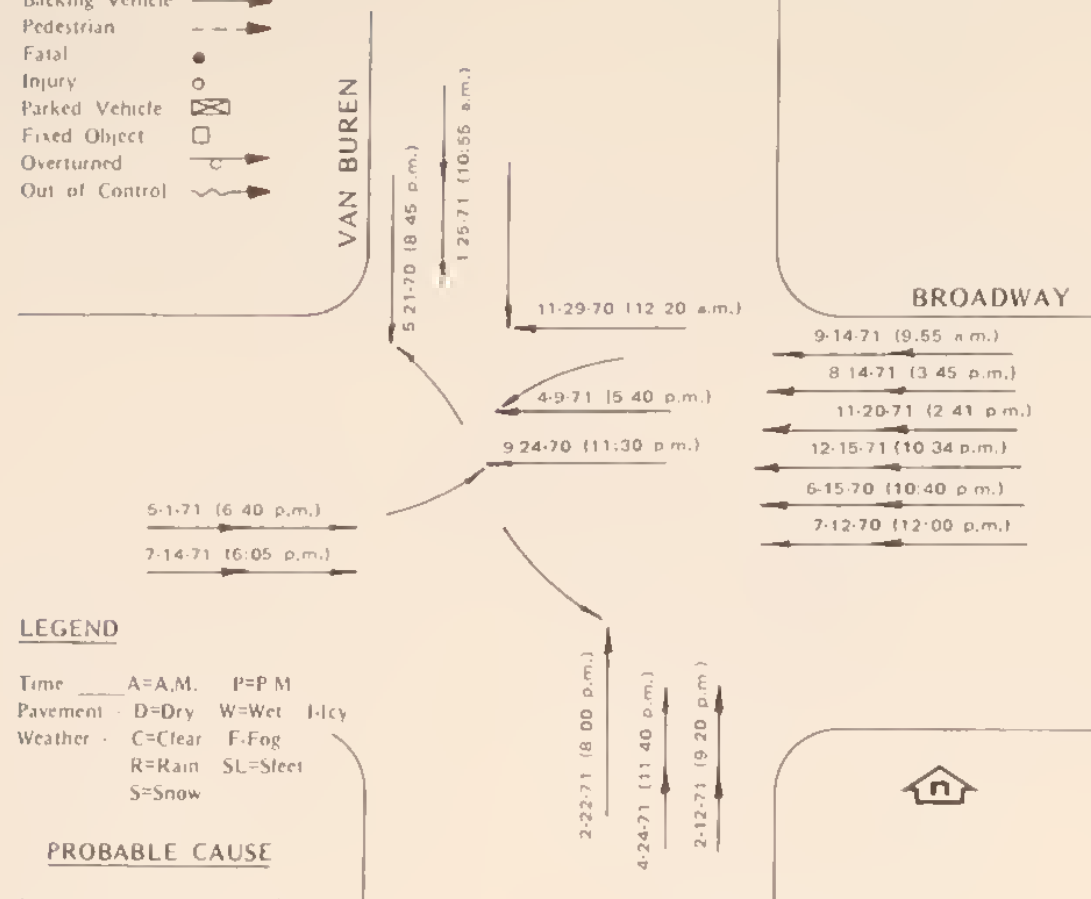
# COLLISION DIAGRAM

CITY OF MISSOULA  
1970 to 1971

## LEGEND - SYMBOLS

Moving Vehicle →  
Backing Vehicle →  
Pedestrian →  
Fatal ●  
Injury ○  
Parked Vehicle ☒  
Fixed Object □  
Overturned ↺  
Out of Control ↻

## BROADWAY & VAN BUREN





## TOPICS IMPROVEMENT PROJECT

### Broadway at Madison Street

#### INTRODUCTION

Broadway is the sole east-west through street north of the Clark Fork River and provides service to the heart of the CBD. At this signalized location Broadway carries an AADT of 11,500. The south leg of Madison Street serves 17,300 vehicles daily while the north leg carries an estimated AADT of 4,000. Much of the traffic on these streets is destined to or from nearby Interstate 90, the University Campus, and CBD. As shown in the Improvement Diagram, Broadway and the south leg of Madison Street are side multi-lane facilities, and the left-lane turn movement is extremely heavy from westbound Broadway to southbound Madison Street as is also the reverse movement. The AADT counterparts to the January turning movement counts shown are of the order of ten percent higher than these counts, with summertime volumes greater yet. This location ranks along with Broadway at Orange Street as the second highest accident location in the city in terms of total accidents, with 31 for the 1970-71 period. It ranks 9th on an accident rate basis.

#### SCOPE OF WORK

A new signal layout including long-span signal mast arms is recommended along with a new five-phase signal controller initially providing three-phase plus overlap phasing. With curb parking removed, the heavy left-turn movement on the west approach of Broadway will be served by a left-turn lane and an optional left-through lane. This movement will be placed on a separate phase from eastbound traffic. Median island and corner modifications and lane striping on the south approach of Madison Street will facilitate the dual left-turn from Broadway and the heavy eastbound right-turn to Broadway. This signal controller will provide for possible future placement of left-turns from the south approach of Madison on a phase separate from the north approach. Lane control signs are provided for eastbound traffic on the mast arm pole and should be provided in advance of the intersection perhaps in combination with the proposed destination signing.

It is recommended that the sign bridge on the west leg of Broadway be removed and replaced as required with cantilever signs with new destination messages further removed from the intersection. This sign bridge could be utilized on Brooks Avenue south of South Avenue should construction scheduling permit.

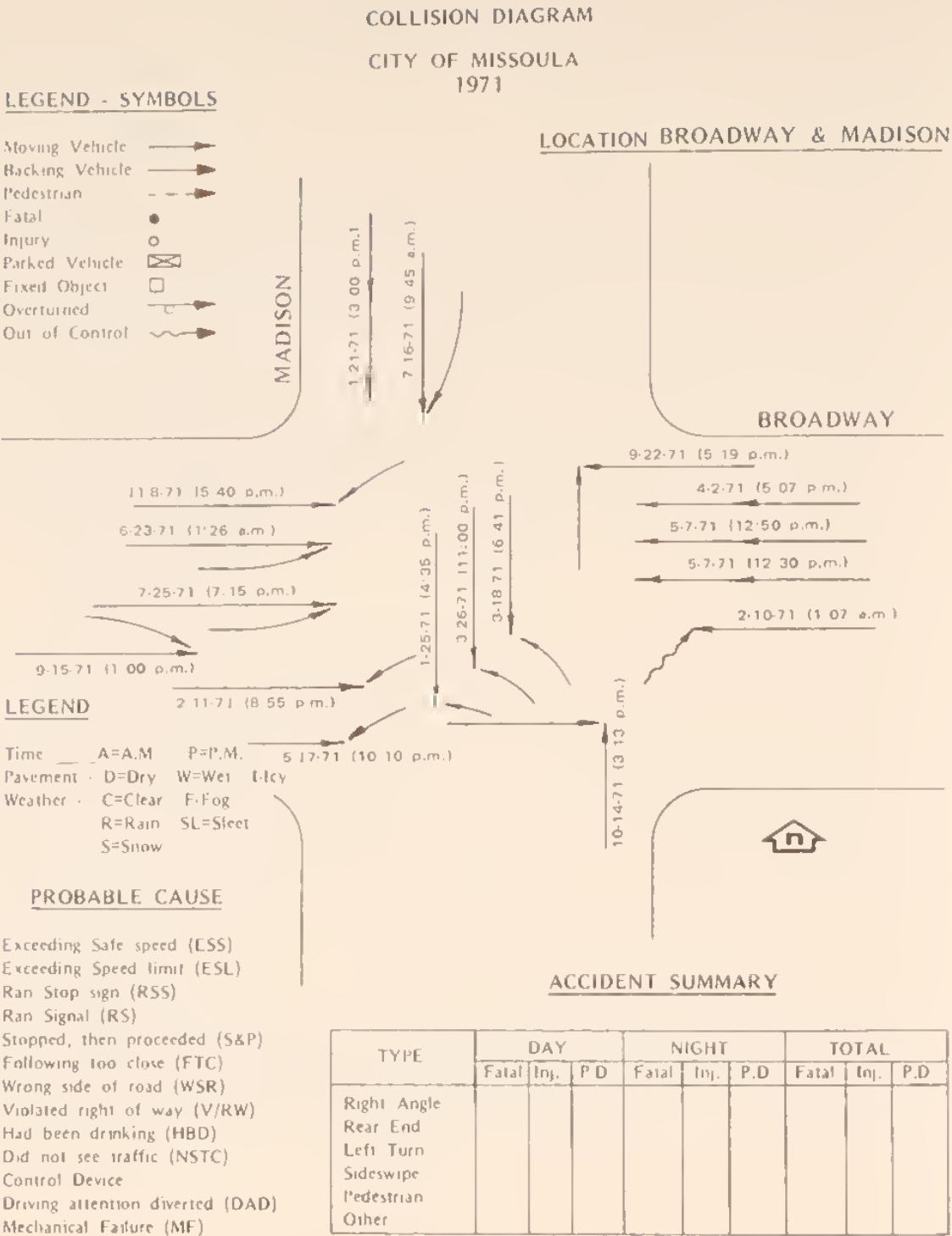
## BROADWAY AND MADISON STREET

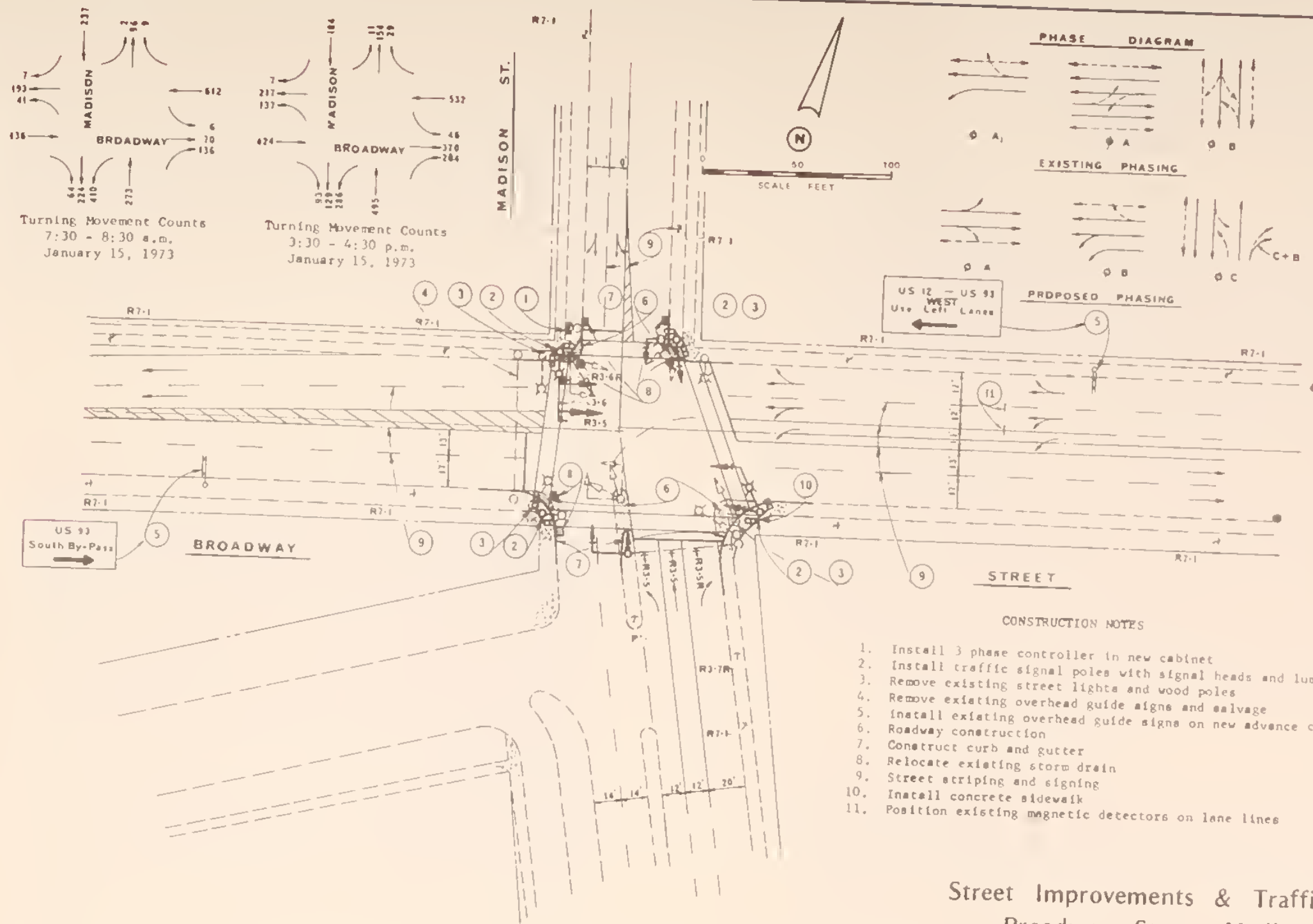
### COST ESTIMATE

|     | Description                                           | Estimated Quantity | Unit | Unit Cost   | Total Cost   |
|-----|-------------------------------------------------------|--------------------|------|-------------|--------------|
| 1.  | Install 5-phase controller complete                   | 1                  | Ea.  | \$12,000.00 | \$ 12,000.00 |
| 2.  | Traffic signal poles complete with signal heads, etc. |                    |      |             |              |
|     | 30' Mast Arm                                          | 1                  | Ea.  | 2,800.00    | 2,800.00     |
|     | 20' Mast Arm                                          | 1                  | Ea.  | 2,200.00    | 2,200.00     |
|     | 15' Mast Arm                                          | 2                  | Ea.  | 1,900.00    | 3,800.00     |
| 3.  | Conduit and wiring                                    | 50                 | L.F. | 6.00        | 300.00       |
| 4.  | New conductors                                        | 280                | L.F. | 1.25        | 350.00       |
| 5.  | Junction boxes                                        | 3                  | Ea.  | .65         | 195.00       |
| 6.  | Remove and salvage existing traffic signals           | 1                  | L.S. | 1,200.00    | 1,200.00     |
| 7.  | Remove and salvage existing lights and poles          | 1                  | L.S. | 600.00      | 600.00       |
| 8.  | Street excavation                                     | 30                 | C.Y. | 3.00        | 90.00        |
| 9.  | Roadway construction                                  | 90                 | S.Y. | 6.00        | 540.00       |
| 10. | Concrete curb and gutter                              | 300                | L.F. | 7.50        | 2,250.00     |
| 11. | Relocate storm drain                                  | 3                  | Ea.  | 250.00      | 750.00       |
| 12. | Street striping                                       | 1                  | L.S. | 400.00      | 400.00       |
| 13. | Signing                                               | 1                  | L.S. | 6,200.00    | 6,200.00     |
|     | Sub Total                                             |                    |      |             | \$ 33,675.00 |
|     | Contingencies, 10%                                    |                    |      |             | 3,368.00     |
|     |                                                       |                    |      |             | \$ 37,043.00 |
|     | Construction Engineering, 10%                         |                    |      |             | 3,704.00     |
|     | GRAND TOTAL                                           |                    |      |             | \$ 40,747.00 |

JUSTIFICATION

The proposed phasing and lane arrangement for the left-turn from the east approach of Broadway will reduce delay and improve safety for that movement. Nearly one-quarter of the accidents at this location involved collisions between that left-turn and opposing through traffic. Overall safety will be improved from improved signal visibility provided by the new signal mast arms and removal of the sign bridge. The proposed improvements should reduce the volume-to-capacity ratio from its present level of 0.50 to 0.35. The intersection volumes obviously meet Warrant No. 1 for signalization, but are not included as part of this project report. Signalization is justified under Warrant No. 7 (See turning movement counts on Improvement Diagram). Since adequate off-street parking exists for nearly all of the commercial establishments, which represent the predominant abutting use along Broadway, the recommended prohibition of curb parking should result in no serious hardship for commercial establishments.





## TOPICS IMPROVEMENT PROJECT

Higgins Avenue: Mount Avenue, Beckwith Avenue  
and Hill Street

### INTRODUCTION

Mount and Beckwith Avenues constitute an important east-west route across the south-central area of the city. However, these streets are slightly offset from each other at their termini at Higgins Avenue. Hill Street provides a diagonal connection between these two streets. Mount Avenue carries an AADT of 2,600, while Beckwith Avenue carries an AADT of 1,600 on the east leg and Beckwith Street an AADT of 2,000 on the northwest leg. At this location Higgins Avenue serves 10,500 vehicles daily. Mount and Beckwith Avenues and Hill Street are under stop-sign control at Higgins Avenue. Five accidents were reported for Higgins Avenue at Mount Avenue for 1970-71 and six accidents for Higgins Avenue at Beckwith Avenue/Hill Street.

Beckwith Avenue terminates on the east side of the city on a Montana State University Campus feeder road which provides access to a major portion of the campus parking lots. To date, Mount Avenue has not been fully developed as a secondary arterial in that without signalization at Stephens Avenue, Brooks Street, and Higgins Avenue, the route is very difficult to travel. All three intersections are multi-leg with no channelization and with insufficient gaps on the major streets are potentially quite hazardous. If the three signals are installed as proposed herein, Mount Avenue will serve as a secondary arterial and will provide an alternate route to the campus and the commercial area north of Brooks Street.

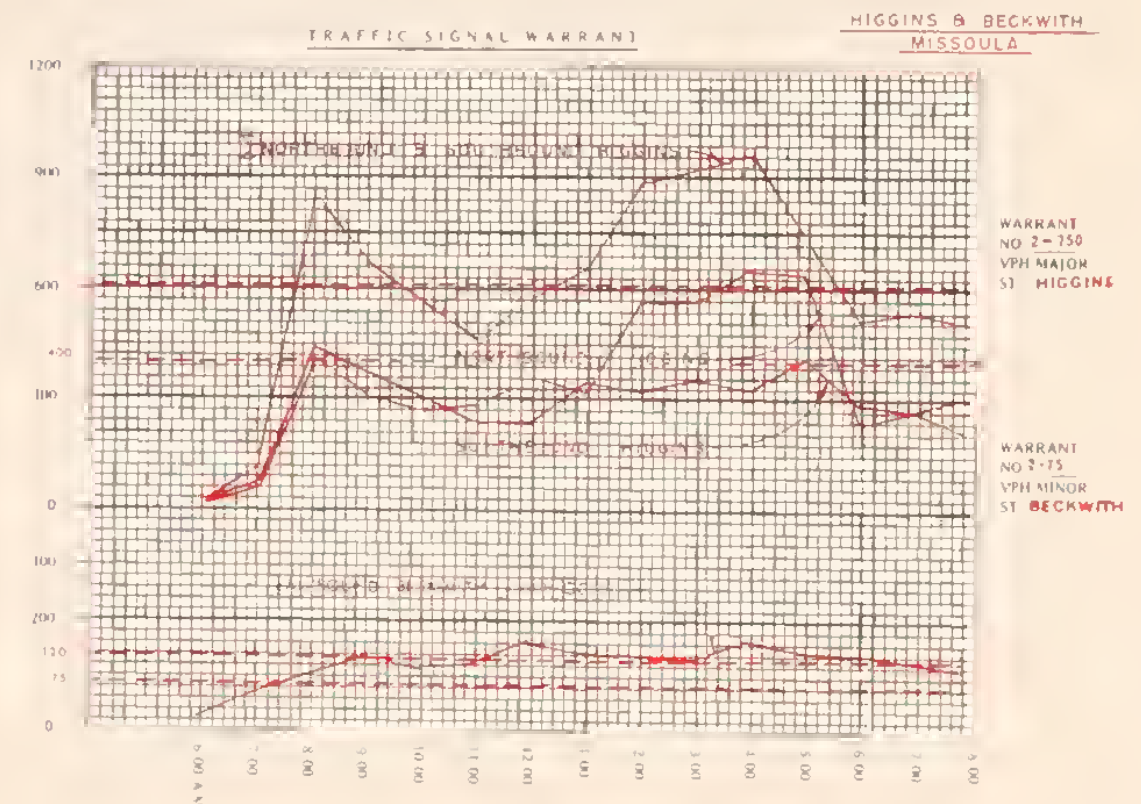
The Mount Avenue roadway between Higgins Avenue and Stephens Avenue is 40 feet wide and the pavement surface is in good condition.

### JUSTIFICATION

The recommended roadway changes on Hill Street will provide a smoother, safer linkage for service of the Mount Avenue/Beckwith Avenue cross-town travel demand. The number of hazardous and delay-producing conflicting traffic movements generated by the five closely spaced existing intersections will be substantially reduced. The combined approach volumes on Beckwith and Mount Avenues satisfy Warrant No. 2 for 5 hours of the required 8. During the other 3 hours the traffic volume on the major street (Higgins Avenue) is satisfied to the extent of 88% of the required value. The approach volumes satisfy Warrant No. 8 for 8 hours and satisfy Warrant No. 7 for 5 hours of the day. The volumes shown for the minor streets (Beckwith Avenue and Mount Avenue) are not a true reflection

of the actual traffic on this street: some traffic volume dispersion occurs to Evans Street because of the present traffic control system and the traffic volumes shown on the warrant sheet were collected prior to Montana State University convening for the Fall Term.

Also, as contained in the School Crossing Protection Devices Project, the pedestrian signals at Higgins Avenue and Hastings Street and at Higgins Avenue and Evans Street are to be removed, and the school children will be rerouted to this location. Expected mid-day through and turning traffic movements at the proposed signal following construction of this project are also shown on the Improvement Diagram and are based upon a reassignment of current traffic movements at Higgins/Mount Avenues, and Higgins Avenue/Hill Street/Beckwith Avenue.





SCOPE OF WORK

Roadway widening on Beckwith Avenue and on Hill Street at Higgins Avenue is recommended along with the installation of two-phase semi-actuated traffic signals at the intersection with Higgins Avenue. Channelization is proposed for the secondary intersection of Mount Avenue and Hill Street, and the short section of Beckwith Street between Hill Street and Higgins Avenue is narrowed with curbing and landscaping and converted to one-way southbound operation. Minor right-of-way acquisition at the southeast corner of Beckwith Avenue is required, but the cost of same was not included in the project cost estimates.

HIGGINS AVENUE AND BECKWITH STREET-MOUNT AVENUE

| COST ESTIMATE                                                              |                    |      |            |              |
|----------------------------------------------------------------------------|--------------------|------|------------|--------------|
| Description                                                                | Estimated Quantity | Unit | Unit Cost  | Total Cost   |
| 1. 2-Phase semi-actuated controller with cabinet complete, installed       | 1                  | Ea.  | \$3,500.00 | \$ 3,500.00  |
| 2. Signal poles with foundations, luminaires, and signal hardware complete |                    |      |            |              |
| 20' Mast Arm                                                               | 3                  | Ea.  | 2,200.00   | 6,600.00     |
| 30' Mast Arm                                                               | 1                  | Ea.  | 2,800.00   | 2,800.00     |
| 3. Pedestrian heads                                                        | 8                  | Ea.  | 190.00     | 1,520.00     |
| 4. Conduit and wire                                                        | 280                | L.F. | 6.00       | 1,680.00     |
| 5. Junction boxes                                                          | 6                  | Ea.  | 65.00      | 390.00       |
| 6. Service                                                                 | 1                  | Ea.  | 200.00     | 200.00       |
| 7. Inductive loop detectors                                                | 5                  | Ea.  | 250.00     | 1,250.00     |
| 8. Street excavation                                                       | 165                | C.Y. | 3.00       | 495.00       |
| 9. Roadway construction                                                    | 500                | S.Y. | 6.00       | 3,000.00     |
| 10. Curb and gutter removal                                                | 655                | L.F. | 2.00       | 1,310.00     |
| 11. Construct concrete sidewalk                                            | 107                | S.Y. | 6.00       | 642.00       |
| 12. Construct concrete curb and gutter                                     | 750                | L.F. | 7.00       | 5,250.00     |
| 13. Construct Type B concrete curbs                                        | 250                | L.F. | 3.00       | 750.00       |
| 14. Relocate drain inlet                                                   | 1                  | Ea.  | 150.00     | 150.00       |
| 15. Street striping and signing                                            | 1                  | L.S. | 300.00     | 300.00       |
| Sub Total                                                                  |                    |      |            | \$ 29,837.00 |
| Contingencies, 10%                                                         |                    |      |            | 2,984.00     |
|                                                                            |                    |      |            | \$ 32,821.00 |
| Construction Engineering, 10%                                              |                    |      |            | 3,282.00     |
| GRAND TOTAL                                                                |                    |      |            | \$36,103.00  |



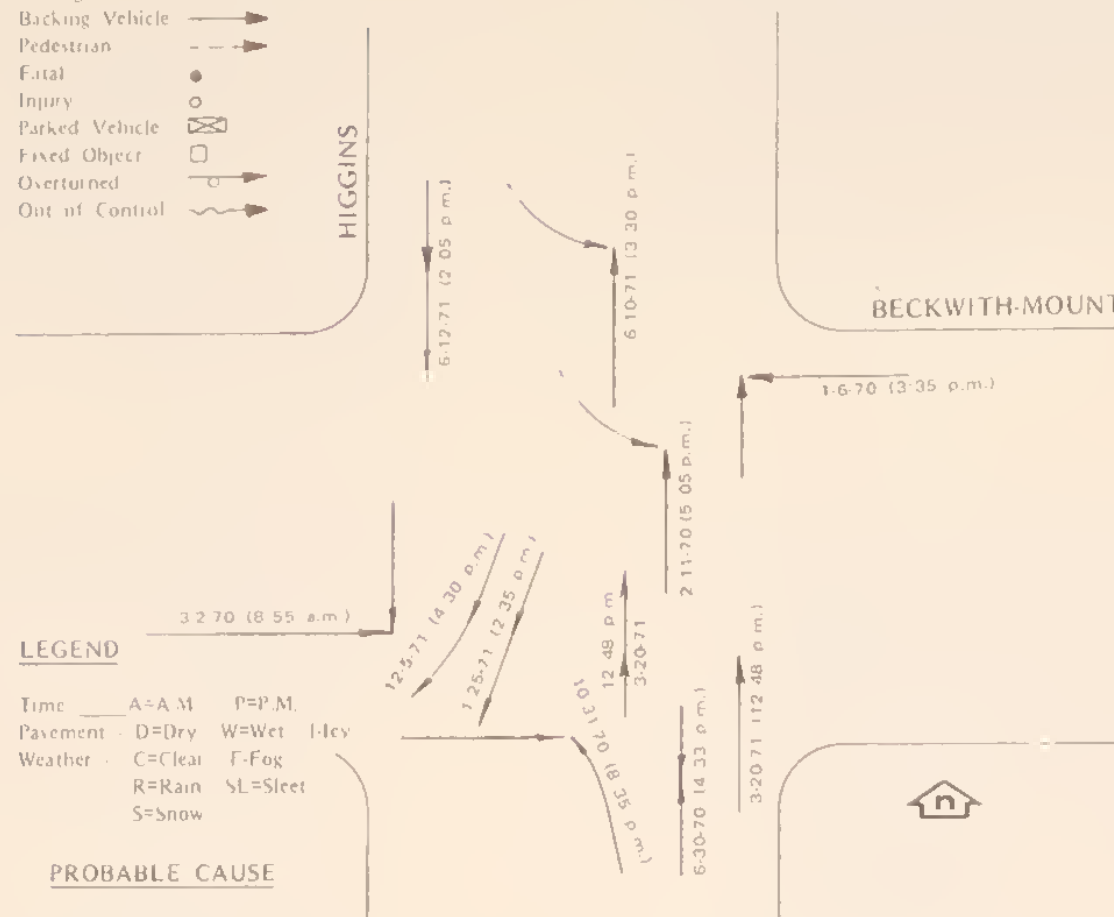
# COLLISION DIAGRAM

CITY OF MISSOULA  
1970 to 1971

## LEGEND - SYMBOLS

Moving Vehicle →  
Backing Vehicle →  
Pedestrian - - - →  
Fatal ●  
Injury ○  
Parked Vehicle ⊠  
Fixed Object □  
Overturned ○→  
Out of Control ~→

## LOCATION HIGGINS-BECKWITH-MOUNT



## LEGEND

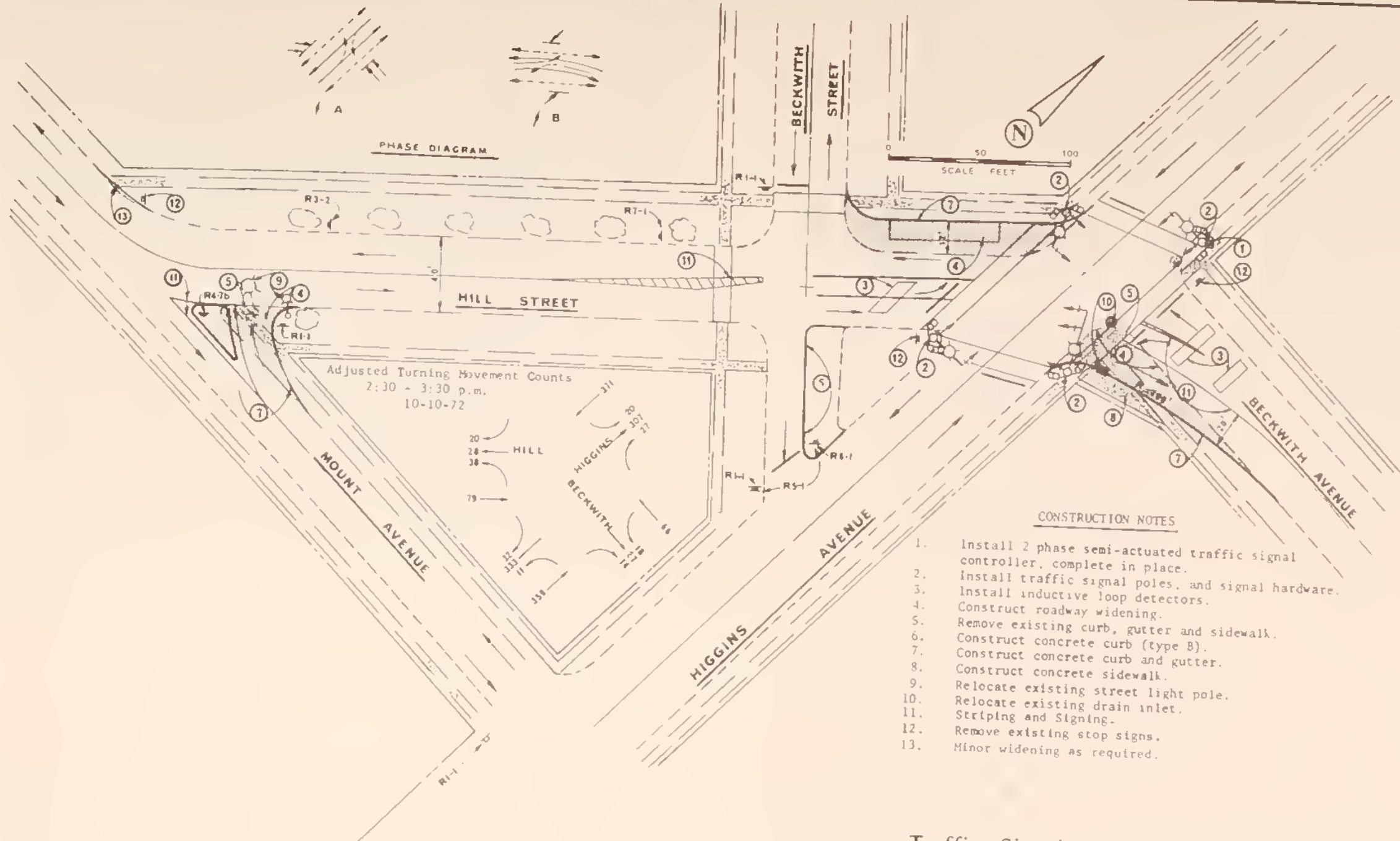
Time \_\_\_\_ A=A.M. P=P.M.  
Pavement - D=Dry W=Wet I-Icy  
Weather - C=Clear F-Fog  
R=Rain SL=Sleet  
S=Snow

## PROBABLE CAUSE

Exceeding Safe speed (ESS)  
Exceeding Speed limit (E.S.L.)  
Ran Stop sign (RSS)  
Ran Signal (RS)  
Stopped, then proceeded (S&P)  
Following too close (FTC)  
Wrong side of road (WSR)  
Violated right of way (V/RW)  
Had been drinking (HBD)  
Did not see traffic (NSTC)  
Control Device  
Driving attention diverted (DAD)  
Mechanical Failure (MF)

## ACCIDENT SUMMARY

| TYPE        | DAY   |     |     | NIGHT |     |     | TOTAL |     |     |
|-------------|-------|-----|-----|-------|-----|-----|-------|-----|-----|
|             | Fatal | Inj | P.D | Fatal | Inj | P.D | Fatal | Inj | P.D |
| Right Angle |       |     |     |       |     |     |       |     |     |
| Rear End    |       |     |     |       |     |     |       |     |     |
| Left Turn   |       |     |     |       |     |     |       |     |     |
| Sideswipe   |       |     |     |       |     |     |       |     |     |
| Pedestrian  |       |     |     |       |     |     |       |     |     |
| Other       |       |     |     |       |     |     |       |     |     |



Traffic Signals and Street Improvements  
Higgins Ave. and Beckwith St./Mount Ave.

TOPICS IMPROVEMENT PROJECT

Brooks Street at Reserve Street

INTRODUCTION

Brooks Street (U.S. 93) carries approximately 11,000 vehicles per day at this skewed intersection with Reserve Street, which has an AADT of 3,900 and is under stop-sign control. The speed limit on Brooks Street is 45 mph. The wide intersection area is complicated by a railroad track crossing through the center of the intersection. Two accidents occurred here in 1971.

A new shopping center is opening in the southeast quadrant of the intersection. In addition, the State Highway Department has proposed extending Reserve Street north across the Clark Fork River to connect through to Broadway and Interstate 90 (1975-1976), which will create a city by-pass for through traffic. Reserve Street would possibly replace Brooks Street-Stephens Avenue-Orange Street as U.S. 93. Therefore, any current improvements to this location must be flexible with regard to these future conditions.

JUSTIFICATION

Since the 85th percentile speed on Brooks Street exceeds 40 mph, this intersection satisfies 70% of Warrant No. 1 for 9 hours for signalization. The need for signalization will increase with the new traffic patterns which will result from the shopping center.

SCOPE OF WORK

It is proposed that this intersection be signalized initially with a two-phase full-actuated controller expandible to five-phase with a railroad pre-empter. At the time Reserve Street is constructed, left-turn protection on Brooks Street will probably be warranted. However, the opposite left-turn volumes should be unequal and should peak at different periods of the day. Thus, a five-phase operation will be the most efficient.

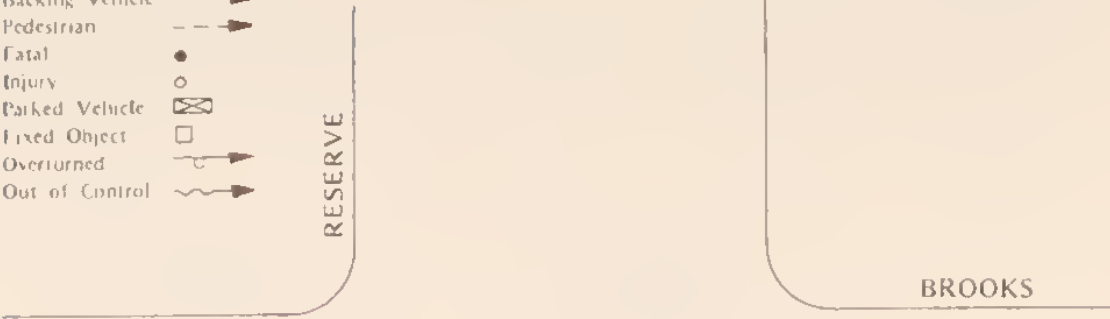
Supplementary nearside signals are required, with roadside signals on all approaches and signal heads on the back of the Brooks Street mast arms. If the Railroad and Public Service Commission agrees, the signal could also function as the railroad grade-crossing protection device.

COLLISION DIAGRAM  
CITY OF MISSOULA  
1971

LEGEND - SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Pedestrian
- Fatal
- Injury
- Parked Vehicle
- Fixed Object
- Overturned
- Out of Control

LOCATION BROOKS & RESERVE



11-3-71 16 00 p.m.

12 15-71 18 00 a.m.

LEGEND

- Time A=A.M. P=P.M.
- Pavement D=Dry W=Wet I-Icy
- Weather C=Clear F=Fog R=Rain SL=Sleet S=Snow

PROBABLE CAUSE

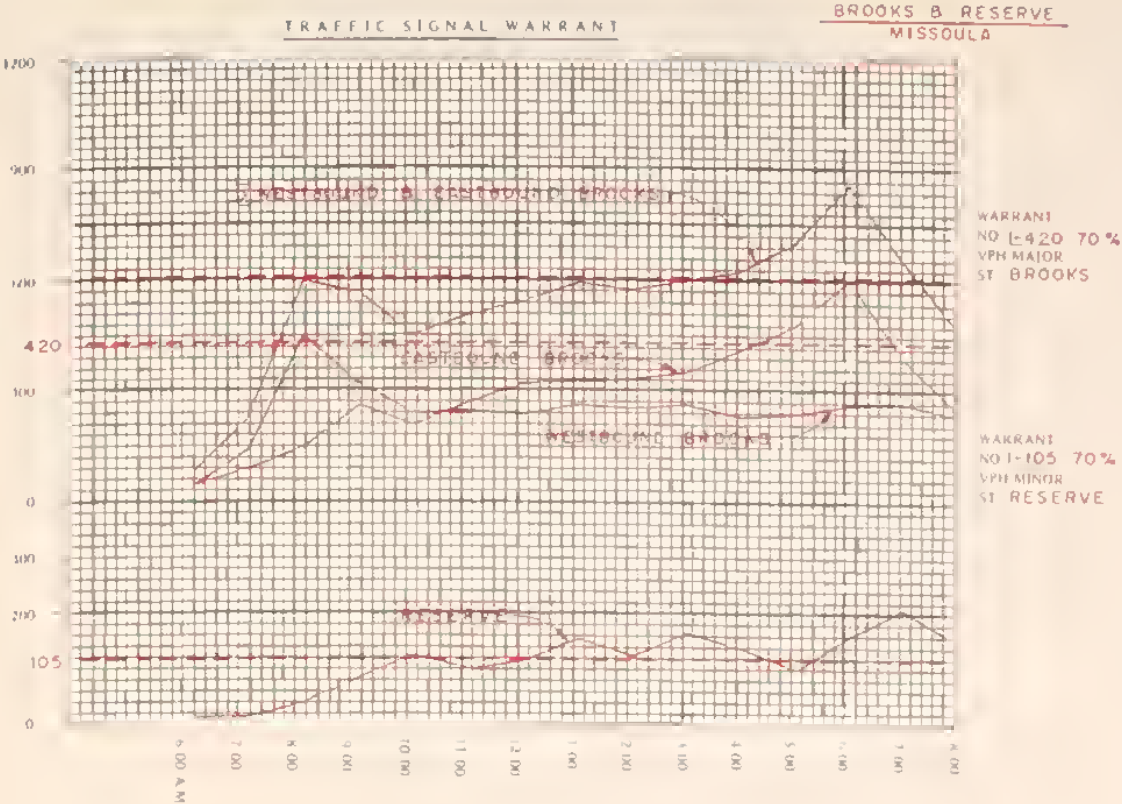
- Exceeding Safe speed (ESS)
- Exceeding Speed limit (ESL)
- Ran Stop sign (RSS)
- Ran Signal (RS)
- Stopped, then proceeded (S&P)
- Following too close (FTC)
- Wrong side of road (WSR)
- Violated right of way (V/RW)
- Had been drinking (HBD)
- Did not see traffic (NSTC)
- Control Device
- Driving attention diverted (DAD)
- Mechanical Failure (MF)

ACCIDENT SUMMARY

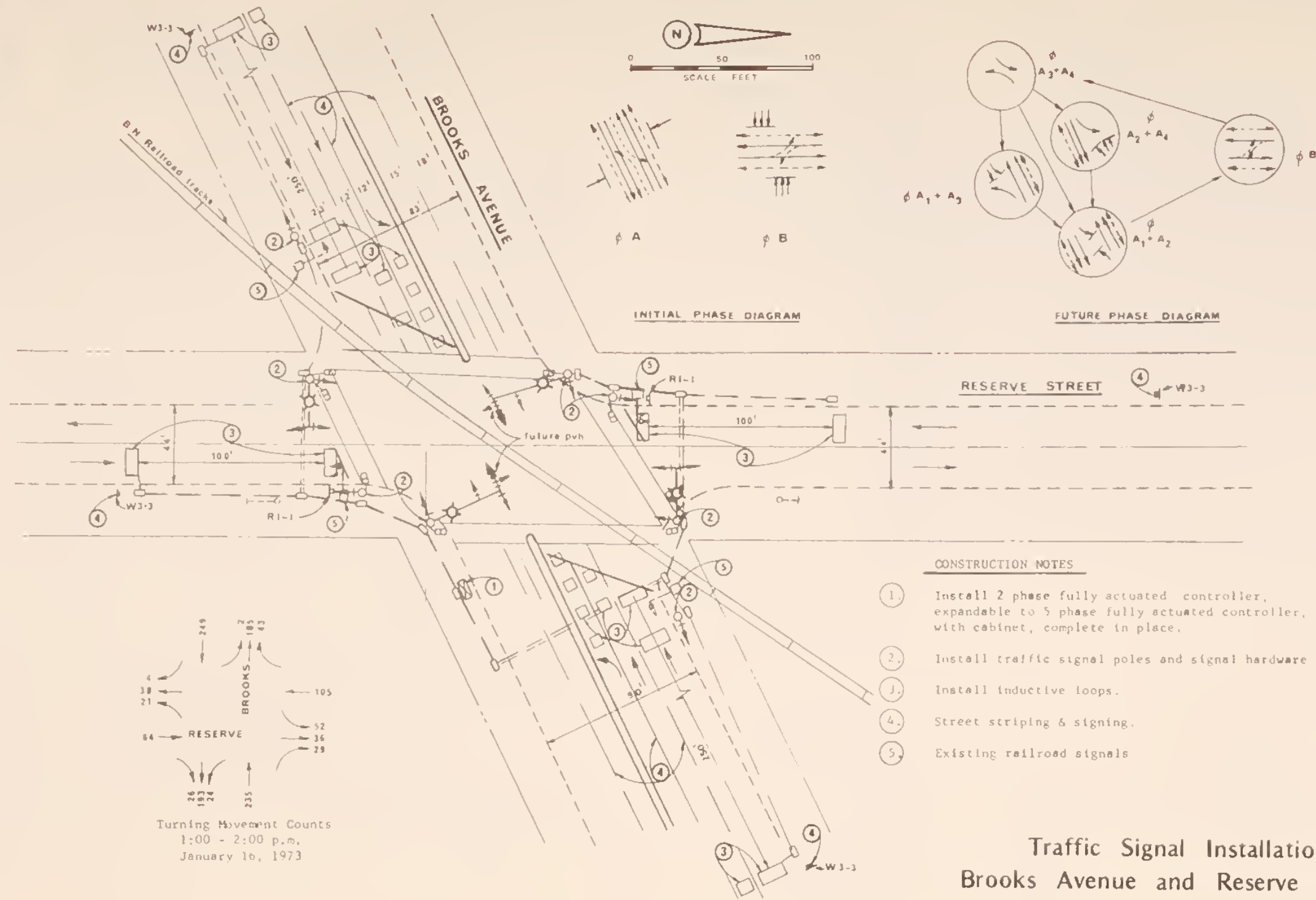
| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |

BROOKS AVENUE AND RESERVE STREET

COST ESTIMATE



| Description                                                                                                                         | Estimated Quantity | Unit | Unit Cost   | Total Cost  |
|-------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|-------------|-------------|
| 1. 2-Phase fully actuated controller expandable to 5 phases with railroad pre-emptor in cabinet completely wired for future phasing | 1                  | L.S. | \$31,000.00 | \$31,000.00 |
| 2. Traffic signal poles with foundations, signals 2 directions, complete with luminaires                                            |                    |      |             |             |
| 25' Mast Arm                                                                                                                        | 2                  | Ea.  | 2,200.00    | 4,400.00    |
| 40' Mast Arm                                                                                                                        | 2                  | Ea.  | 2,900.00    | 5,800.00    |
| 10' signal poles with heads complete                                                                                                | 4                  | Ea.  | 500.00      | 2,000.00    |
| 3. Pedestrian heads                                                                                                                 | 8                  | Ea.  | 190.00      | 1,520.00    |
| 4. Conduit and wire, 2" and 3"                                                                                                      | 300                | L.F. | 7.00        | 2,100.00    |
| 5. Junction boxes                                                                                                                   | 17                 | Ea.  | 65.00       | 1,105.00    |
| 6. Inductive loop detectors                                                                                                         | 24                 | Ea.  | 250.00      | 6,000.00    |
| 7. Street striping and signing                                                                                                      | 1                  | L.S. | 300.00      | 300.00      |
| Sub Total                                                                                                                           |                    |      |             | \$54,225.00 |
| Contingencies, 10%                                                                                                                  |                    |      |             | 5,422.00    |
|                                                                                                                                     |                    |      |             | \$59,647.00 |
| Construction Engineering, 10%                                                                                                       |                    |      |             | 5,965.00    |
| GRAND TOTAL                                                                                                                         |                    |      |             | \$65,612.00 |





## TOPICS IMPROVEMENT PROJECT

### School Crossing Protection Devices

#### INTRODUCTION

The system of school crossings protection devices in use in the City of Missoula and adjacent urbanized areas lacks consistency in terms of design and application features and for the most part lacks conformity with national standards as embodied in the *Manual on Uniform Traffic Control Devices for Streets and Highways*. Appendix A presents a recommended policy guide and standards for school crossing traffic control for the City of Missoula. This guide was used in appraising the city's needs for an improved system of school crossing locations.

#### JUSTIFICATION

The proposed school crosswalk system utilizing standard, uniform design treatments based upon consistent application of need warrants should provide both increased safety to school pedestrians and reduced delay to motorists.

#### SCOPE OF WORK

The following school crossing locations are recommended for the improvement and/or modification noted. The total improvement program cost is estimated at \$84,000.

#### INSTALL SCHOOL CROSSWALK † SIGNING AND MARKINGS (\$900, TOTAL)

- 3rd Avenue at Hawthorne School
- Bancroft Street at Pattee Canyon Drive
- Toole Avenue at Hawthorne Street
- Van Buren Street at Elm Street
- South Avenue at Bancroft Street (all 4 legs)
- Worden Avenue at Howell Street (or 3rd Street)
- Stoddard Street at Worden Avenue
- South 3rd Street at Ash Street

\* Consider school boundary revision in lieu of school crosswalks on Higgins Avenue.

† For single crosswalk located on first-listed street unless otherwise noted.

\*\* New vehicular signals with pedestrian indications are tentatively proposed.

- South 5th Street at Ash Street
- South 6th Street at Ash Street
- Brayton Street at Mountain View Street
- Reserve Street at South Avenue

#### INSTALL SCHOOL CROSSWALK SIGNING AND MARKINGS AT INTERSECTIONS AT WHICH EXISTING SIGNALS ARE TO BE IMPROVED OR AT WHICH PROPOSED SIGNALS ARE TO BE CONSTRUCTED (\$600, TOTAL)

- Arthur Avenue at Beckwith Avenue
- Higgins Avenue at Beckwith Avenue (both legs of Higgins Avenue \* and east leg of Beckwith Avenue)
- Higgins Avenue at South Avenue
- 39th Street at Russell Street
- Brooks Street at Beckwith Street
- Stephens Avenue at Beckwith Street
- Higgins Avenue at South 6th Street

#### REMOVE EXISTING SCHOOL PEDESTRIAN SIGNALS (\$1,500, TOTAL)

- South 3rd Street east of Hiberta Avenue (Hawthorne School)
- Spruce Street at Owen Street
- Higgins Avenue at Evans Street \*
- Van Buren Street at Elm Street
- Brayton Street at Mountain View Street
- 39th Street west of Russell Street
- Worden Avenue Between Phillips Street and Howell Street

#### RECONSTRUCT EXISTING SCHOOL PEDESTRIAN SIGNALS (\$71,000 TOTAL)

- South Avenue at Garfield Street\*\*
- South Avenue at Clements Street\*\*
- South 3rd Street at Curtis Street
- Reserve Street at North Avenue\*\*
- Russell Street at Russell School

#### INSTALL NEW SCHOOL PEDESTRIAN SIGNALS (\$10,000, TOTAL)

Southwest Higgins Avenue near Park Street

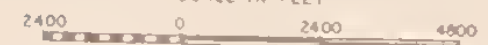
(The provision of vehicular signals with pedestrian indication at Pattee Canyon Drive and South Higgins Avenue in lieu of pedestrian-only signals at the above location was also considered, but appears that resultant traffic delays along with sight distance restrictions at the latter make the Park Drive location preferable.)

It is recommended that school and city traffic officials review the above recommendations with regard to consistency of school routings and the adequacy of sidewalk conditions in relation to the proposed crosswalk locations. The need for installation of flashing school crosswalk warning signs and special speed control signing due to speed and sight distance restriction factors has not been evaluated as it is beyond the scope of this study. However, attention should be given to locations which may warrant installation of such devices.

CITY PLAT  
**MISSOULA**  
 MISSOULA COUNTY  
 MONTANA

1970 CENSUS 29,497

SCALE IN FEET



REVISED DEC 31 1971

BRAYTON MOUNTAIN



**LEGEND**

- ←XXX Install crosswalk signing & markings  
 XXX = Estimated elementary school pedestrian crossing volume, one way
- ✱ Existing pedestrian signal to be removed
- ⊙ Existing pedestrian signal to be reconstructed/modernized
- Proposed pedestrian signal
- Proposed vehicle signal with pedestrian indications
- ⊞ Existing pedestrian signal to be replaced with a vehicle signal



School Crossing Protection



# CHAPTER VII

## SUMMARY OF ADDITIONAL SPOT IMPROVEMENT PROJECTS

### STAGE III

#### NON-TOPICS SPOT IMPROVEMENT PROJECTS

##### Reserve Street and South Avenue

### INTRODUCTION

Reserve Street is presently designated as FAS 430 and will be the major north-south connector between Interstate 90 Freeway and Brooks Avenue for the westerly portion of the city when it is linked up via a new Clark Fork Bridge (tentatively scheduled for 1975-76). Reserve Street has an AADT of 5,500 vehicles north of South Avenue and an AADT of 3,900 vehicles south of South Avenue. South Avenue is the major east-west cross street for the southerly portion of the city, and carries an AADT of 6,800 vehicles to the east and 4,200 vehicles to the west of Reserve Street, respectively. Lightly travelled Fort Missoula Road which is also the entrance to the new hospital, enters from the southwest quadrant, resulting in a five-leg intersection. All approaches are under stop-sign control.

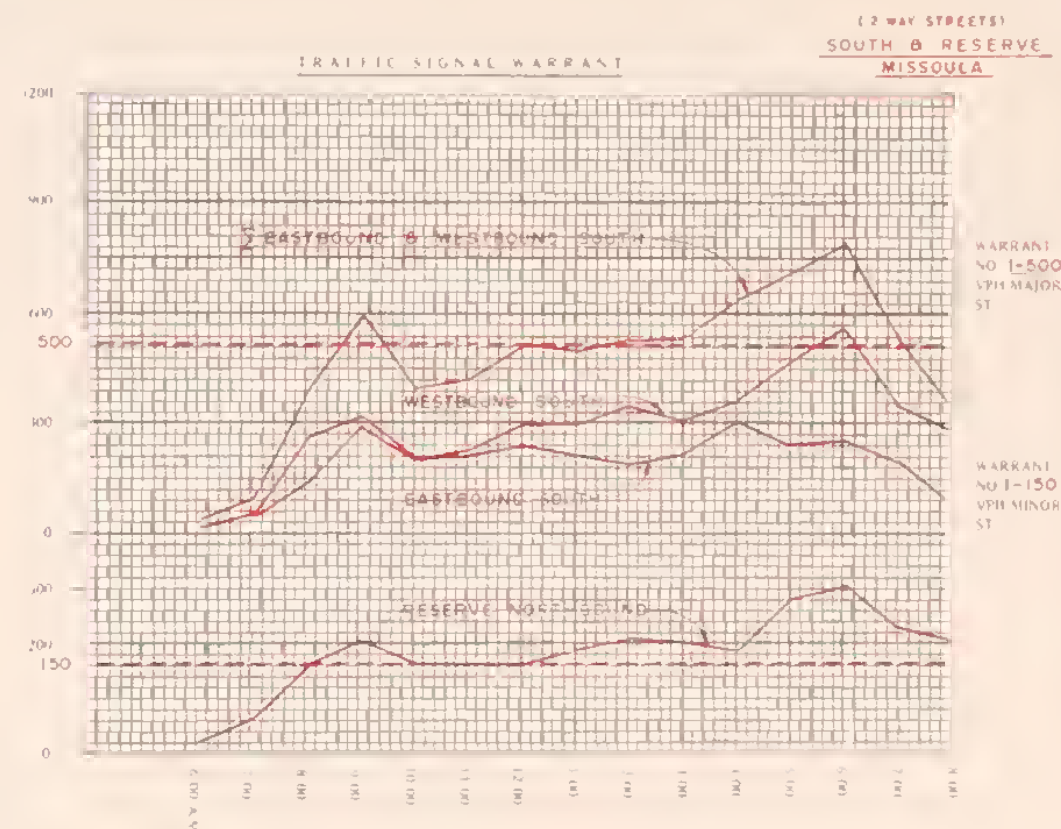
### SCOPE OF WORK

In order to reduce the complexity of movements at this intersection, it is recommended that Fort Missoula Road be realigned to provide two new intersections, one at South Avenue and one at Reserve Street with both of the new intersections well removed from the existing intersection. It is proposed to construct two connecting street segments into Fort Missoula Road. One proposed street is the extension of Dearborn Street, approximately 660' south of South Avenue, which will tie Fort Missoula Road to Reserve Street. The other proposed street is aligned midway between 26th Street and 27th Street approximately 990' west of Reserve Street and will connect South Avenue to Fort Missoula Road. Fort Missoula Road could then be vacated between the take-off point for the new connections and the existing intersection. The County of Missoula has tentatively scheduled the Dearborn Street extension construction for sometime early spring, 1973, utilizing other funds. Since there is no particular traffic congestion problem at the present time, it is recommended that the Reserve Street/South Avenue intersection remain under

stop-sign control until Reserve Street Bridge construction has been completed. At that time a two-phase (expandable to three-phase) full-actuated traffic signal control (approximate cost \$25,000) should be installed.

### JUSTIFICATION

Since no immediate changes are recommended other than the street construction proposed by the County, no project justification is required. However, since a signal is presently warranted under Warrant No. 1, the data is included along with a collision diagram, if priorities or work schedules change.





# COLLISION DIAGRAM

CITY OF MISSOULA  
1970-1972

## LEGEND - SYMBOLS

Moving Vehicle →  
Backing Vehicle →  
Pedestrian - - →  
Fatal •  
Injury ○  
Parked Vehicle ☒  
Fixed Object □  
Overturned ↺  
Out of Control ~→



## LEGEND

Time \_\_\_\_ A=A.M. P=P.M.  
Pavement - D=Dry W=Wet I-Icy  
Weather - C=Clear F-Fog  
R=Rain SL=Sleet  
S=Snow

## PROBABLE CAUSE

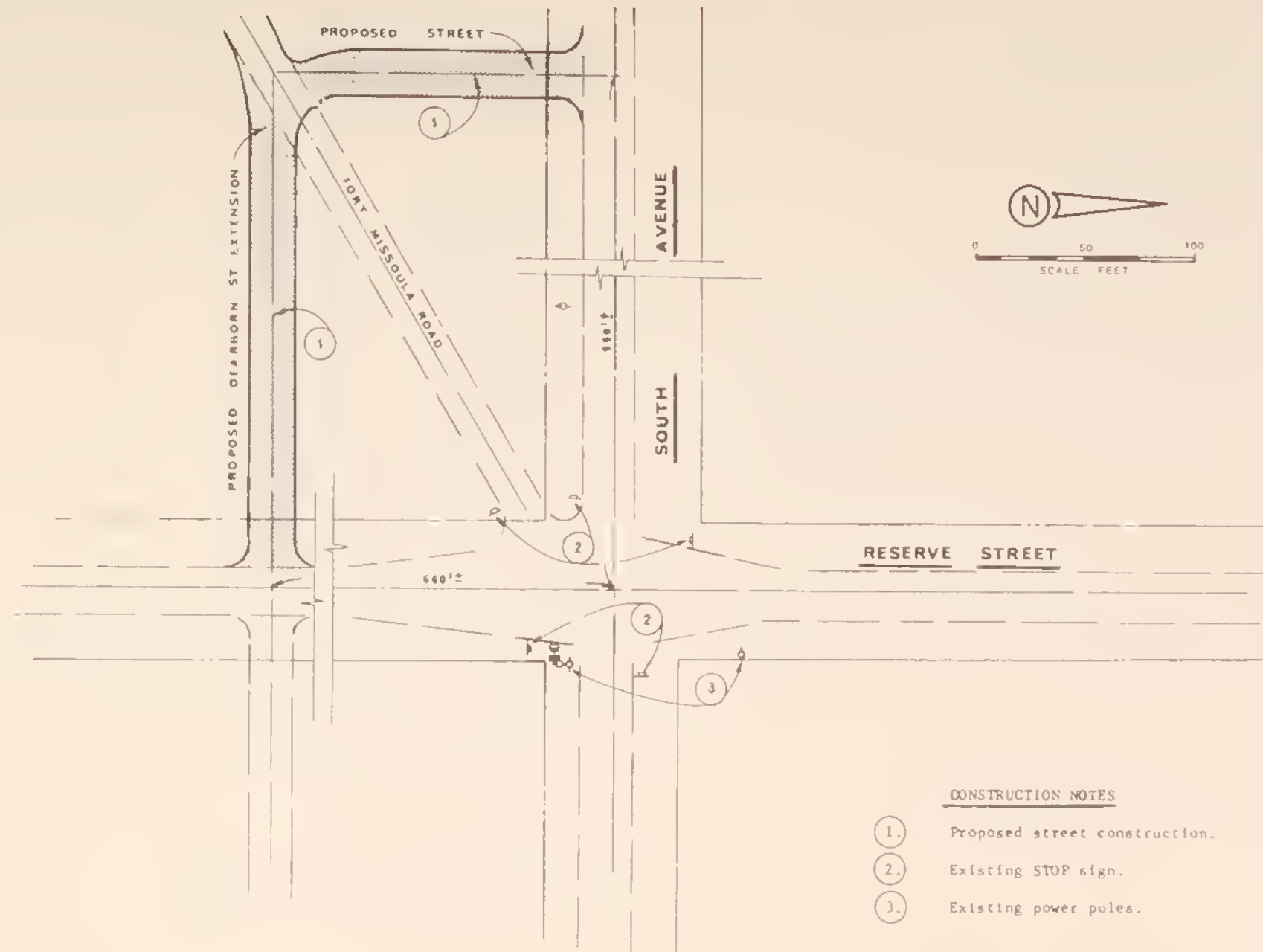
Exceeding Safe speed (ESS)  
Exceeding Speed limit (ESL)  
Ran Stop sign (RSS)  
Ran Signal (RS)  
Stopped, then proceeded (S&P)  
Following too close (FTC)  
Wrong side of road (WSR)  
Violated right of way (V/RW)  
Had been drinking (HBD)  
Did not see traffic (NSTC)  
Control Device  
Driving attention diverted (DAD)  
Mechanical Failure (MF)

1-24-72 (4:30 p.m.)



## ACCIDENT SUMMARY

| TYPE        | DAY   |      |      | NIGHT |      |      | TOTAL |      |      |
|-------------|-------|------|------|-------|------|------|-------|------|------|
|             | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. | Fatal | Inj. | P.D. |
| Right Angle |       |      |      |       |      |      |       |      |      |
| Rear End    |       |      |      |       |      |      |       |      |      |
| Left Turn   |       |      |      |       |      |      |       |      |      |
| Sideswipe   |       |      |      |       |      |      |       |      |      |
| Pedestrian  |       |      |      |       |      |      |       |      |      |
| Other       |       |      |      |       |      |      |       |      |      |



Proposed Improvements  
Reserve Street & South Avenue

## IMPROVEMENT PROJECT

Brooks Street and Beckwith Street

Stephens Street and Beckwith Street

### INTRODUCTION

Beckwith Street is a collector arterial which crosses both Brooks Street and Stephens Street. Semi-actuated signals were installed at the two intersections in 1968 under the F-9999 Funding Program and are almost identical as to signal layout. The signals conform to the requirements in the *Manual on Uniform Traffic Control Devices*. However, 10 accidents occurred at the Brooks Street and Beckwith Street intersection in 1970-1971, and 2 accidents occurred at the Stephens Avenue and Beckwith Street intersection in 1971 - the majority of which were rear-end collisions on Beckwith Street. Based upon field observation, the primary cause seems to be a combination of the detector located some 60 feet from the intersection, a wide variation in approach speeds, and the signal timing.

### SCOPE OF WORK

At both intersections install presence detection between the existing detector and the stop bar on both approaches and add one loop amplifier in each controller cabinet. The estimated cost is \$1,400 for each intersection. Since the proposed work is minor, it is suggested that the maintenance forces accomplish the work, and TOPICS funds not be utilized for same.

## MISCELLANEOUS IMPROVEMENT PROJECTS

Mount Avenue With All Diagonal Streets

Higgins Avenue With All Diagonal Streets

Russell Street With All Diagonal Streets

### INTRODUCTION

Mount Avenue, Higgins Street, and Russell Street are all arterial streets and form the border of the predominant north-south and east-west grid pattern to the one section of land that was originally platted with a northwest-southeast and northeast-southwest grid network. All of the locations contained herein are those multi-legged intersections formed with residential streets. None of the locations has at present a serious accident problem, but as traffic growth continues to grow, the hazard potential will increase and traffic

flow will tend to degenerate due to the large number of conflict points, the large area of the intersections, and the proximity of, in most cases, the three intersections formed by the diagonal streets with the north-south or east-west grid street.

### SCOPE OF WORK:

Mount Avenue at Park Street - Channelize intersection so that Plymouth and Franklin align with Park. Vacate remainder of intersection area or landscape.

At Edith Street - Cul-de-sac Harlem Street.

### SCOPE OF WORK:

Higgins Avenue at diagonal street intersections between Brooks Street and Mount Avenue - Rechannelize intersection by providing a cul-de-sac on one leg or realigning the two side streets into a "Y" intersection. Each diagonal street should be studied individually and basic improvement design recommended based upon predominant traffic flow on the residential streets.

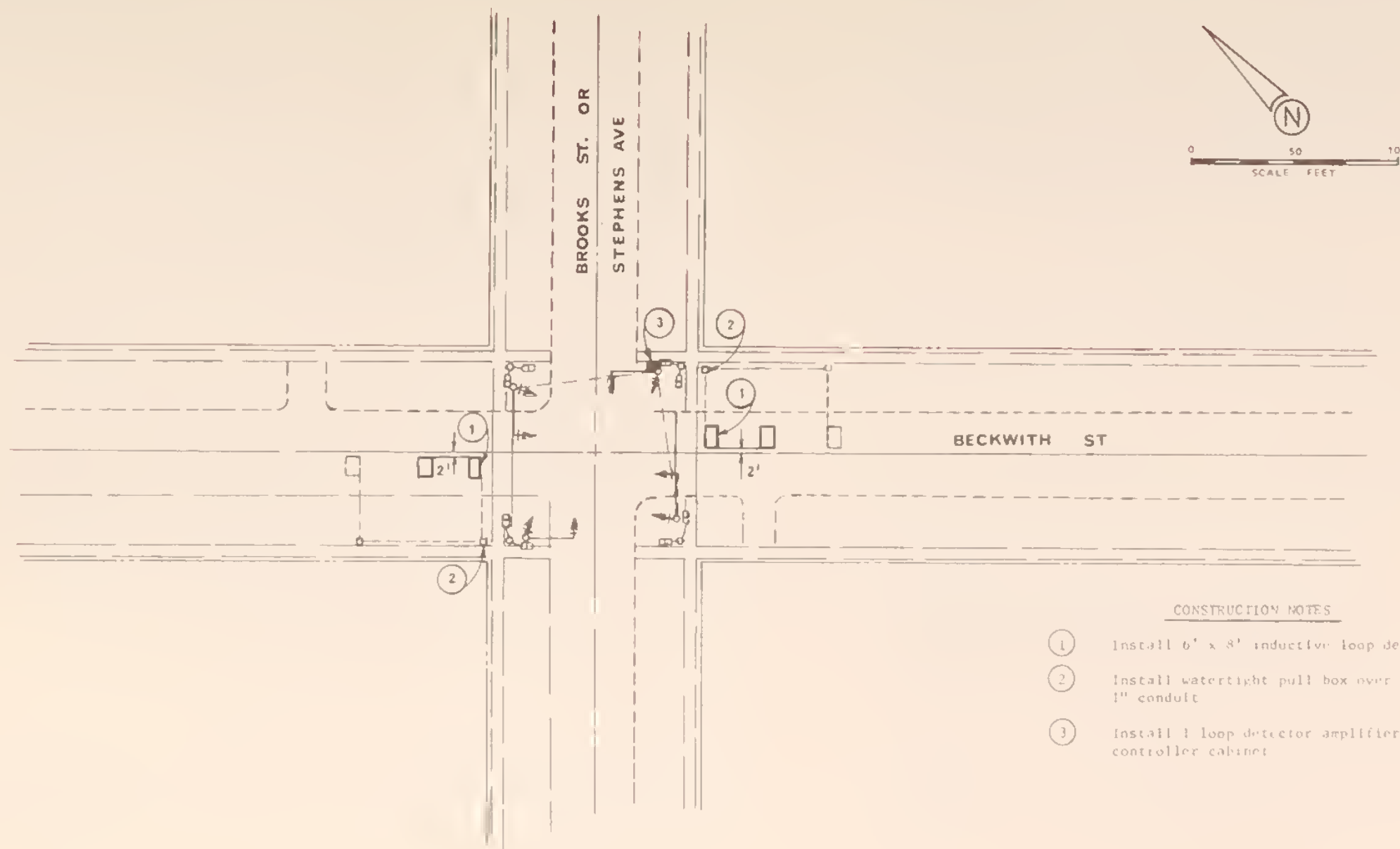
### SCOPE OF WORK:

Russell Street at diagonal street intersections between South 6th Street and Mount Avenue - Rechannelize intersections by providing a cul-de-sac on one leg or realigning the two streets into a "Y" intersection. Each diagonal street should be studied individually and basic improvement design recommended based upon predominant traffic flow on the residential streets.

### COST ESTIMATE:

|                |             |
|----------------|-------------|
| Mount Avenue   | \$ 7,000.00 |
| Higgins Avenue | 7,000.00    |
| Russell Street | 10,000.00   |
|                | <hr/>       |
|                | \$24,000.00 |

Broadway at Toole Avenue  
Broadway at Cedar Street



#### CONSTRUCTION NOTES

- ① Install 6' x 8' inductive loop detectors
- ② Install watertight pull box over existing 1" conduit
- ③ Install 1 loop detector amplifier in existing controller cabinet

Brooks St. and Beckwith St.  
Stephens Ave. and Beckwith St.

## INTRODUCTION:

Both intersections are skewed angle intersections which creates sight distance problems for the motorist stopped on the side streets. Toole Avenue, which is on the TOPICS System, serves as a collector for that area of the city lying between the railroad tracks and Broadway, and carries an AADT of 4,600 vehicles per day. The traffic volume on Broadway at these locations is approximately 18,000 AADT. The Toole Street intersection is ranked 26th in the city by total number of accidents and 31st by accident rate.

## SCOPE OF WORK:

Rechannelize intersections to form right-angled intersections and provide left-turn lanes on Broadway - since the traffic flows on Toole Avenue and Cedar Street are being forced to materially change direction, the channelization should be raised construction as opposed to painted.

COST ESTIMATE: \$5,000.00

Higgins Avenue and Pattee Canyon Drive

## INTRODUCTION:

This intersection is basically a "Y" intersection in that the traffic volume splits almost 50-50 between S.W. Higgins Avenue and Pattee Canyon Drive from South Higgins Avenue. The predominant right-turn movement from Pattee Canyon Drive to north on South Higgins Avenue is predominant and represents approximately 80% of the westbound movement on Pattee Canyon Drive. The reverse left-turn movement from South Higgins to Pattee Canyon Drive is of the same magnitude, and does cause some delays for the through movement from South Higgins Avenue to S.W. Higgins Avenue.

A signal installation at this location will cause more delays to the traffic and will increase the accident potential. If installed and in order to be effective, the controller would have to be three-phase. However, the intersection is several years away from meeting minimum volume warrants.

On the basis of the School Crossing Protection Devices Study, a pedestrian signal may be warranted to cross S.W. Higgins Avenue to serve the school children South of S.W. Higgins Avenue. However, due to minimum sight distance on the south leg (south crosswalk should be used for school crossing) and the turning movements on the north leg, the school crossing signal would be better located at or near Park Street than at this location.

## SCOPE OF WORK:

Widen roadway on the north and south approaches and provide a left-turn lane on the north approach.

COST ESTIMATE: \$8,000.00

Van Buren Street and Missoula Street  
Van Buren Street and Wylie Street

## INTRODUCTION:

These skewed intersections create a sight distance problem for the motorist stopped on the side streets. Neither location has an accident history. If traffic growth continues to grow on Van Buren Street, the hazard potential will increase.

## SCOPE OF WORK:

Van Buren Street at Missoula Street - Construct intersection to perpendicular "T". Grade area between roadway and right-of-way to remove mound of dirt causing sight distance restriction.

At Wylie Street - Construct intersection to perpendicular "T"

COST ESTIMATE: \$25,000.00

Madison Street and Spruce Street

## INTRODUCTION:

The Madison Street movement is stopped at Spruce Street and is slightly greater than the eastbound movement on Spruce Street.

## SCOPE OF WORK:

Rechannelize the intersection and widen the southeast corner to permit free flow from Madison Street to Duncan Drive. At this time, the benefits from this project are marginal; the intersection should be re-examined following the completion of the Madison-Broadway signal reconstruction and the completion of the CBD development plan.



COST ESTIMATE: \$10,000.00

Brooks Street at Roosevelt Street  
Brooks Street at Tremont Street

INTRODUCTION:

The intersection ranks 17th on the high accident list and 10th on the accident rate basis. Vehicles backing up through the intersection from the signal at Higgins Street create a sight distance problem. The majority of the accidents involve the northbound movement on Roosevelt Street attempting to cross through the stopped vehicles.

SCOPE OF WORK:

Consider either closing Roosevelt, right-turn only, or one-way to the southeast between Brooks and Higgins. The new signal installation at Brooks Street and Higgins Avenue may solve the problem, but it appears doubtful.

Also, the next intersection to the south, Brooks Street and Tremont, has appeared on the high accident list for 1972. Further analysis should be accomplished by city or state forces to determine if the stopped vehicles on Brooks Street are creating an identical problem at Tremont Street as at Roosevelt Street.

COST ESTIMATE: Minimal

Higgins Avenue Between Brooks Street and 3rd Street

INTRODUCTION:

All signalized intersections are on the high accident list, and are operating with capacity restraints. The proposed signal project (4-9's) will alleviate part of the problem by providing better signal displays and more flexibility for varying vehicle progression schemes than is now presently possible.

SCOPE OF WORK:

Remove parking on one side of Higgins Avenue or alternatively.

Widen Higgins Avenue between Brooks Street and the bridge in order to provide left-turn lanes at all signalized intersections (except Brooks Street) in order to increase

the capacity of the facility and to reduce the accident potential.

COST ESTIMATE: Alternate A. - Minimal  
B. - \$40,000.00

Note: All signal poles should be located on the 4-9's project to allow for future widening.

MISCELLANEOUS NON-TOPICS IMPROVEMENT PROJECTS

Brayton Street and Lolo Street

Field Condition: Sight distance restriction.

Scope of Work: Remove two trees and shrubs, relocate fence and/or prevent plants from growing on fence.

South 3rd Street and Cottonwood Street

Field Condition: Sight distance restriction. High accident location.

Scope of Work: Remove mail box, one tree, and restrict parking.

South Street and Clements Street

Field Condition: Sight distance restriction.

Scope of Work: Relocate power pole, fence and shrubs.



## APPENDIX

### A POLICY GUIDE AND STANDARDS FOR SCHOOL CROSSING TRAFFIC

#### CONTROL FOR THE CITY OF MISSOULA

##### INTRODUCTION

Maintenance and improvement of the safety of children going to and from school requires a continuing program of education, enforcement, and engineering. This policy guide presents a summary of recommended traffic engineering guides and procedures essential to that safety program.

The *Manual on Uniform Traffic Control Devices for Streets and Highways*\* provides a sound approach to many of the technical aspects associated with school area traffic control, and recommended design and application treatments of the Manual are incorporated herein, along with other recommended guides and practices. The intent of this guide is to help ensure a sound and consistent policy for school traffic safety in the City of Missoula. It does not, however, obviate the need for professional traffic engineering studies in connection with individual problem locations.

##### SCHOOL ROUTES AND CROSSINGS

A school route map should be prepared for each school showing safe routes to school from each block within the school boundaries along with locations of stop signs, traffic signals, adult crossing guards, and grade separated pedestrian crossing structures. Individual school routes should be delineated so that maximum advantage is taken of crossings where these control devices are present, but unduly long or circuitous routes should be avoided.

Factors to be considered in delineating school routes and determining school crossing location needs are:

- The availability of adequate, safe sidewalks or off-roadway walk areas to and from crossings,

- The number of children using the crossing, traffic volume and speed, street width, sight distances, and crossing control (crosswalk signs, stop signs, traffic signals) and,

- The age levels of the children using the crossing.

##### SIGNS AND MARKINGS

School signing and markings must be carefully planned and located in order to secure maximum benefits of advance warning to motorists at reasonable economy.

School signing standards and guides are illustrated in Figure 1. The signs shown are those recommended in the 1971 edition of the *Manual on Uniform Traffic Control Devices*. Existing school signing which does not meet the Manual's design specifications should be replaced with signing which is in conformance with these guides.

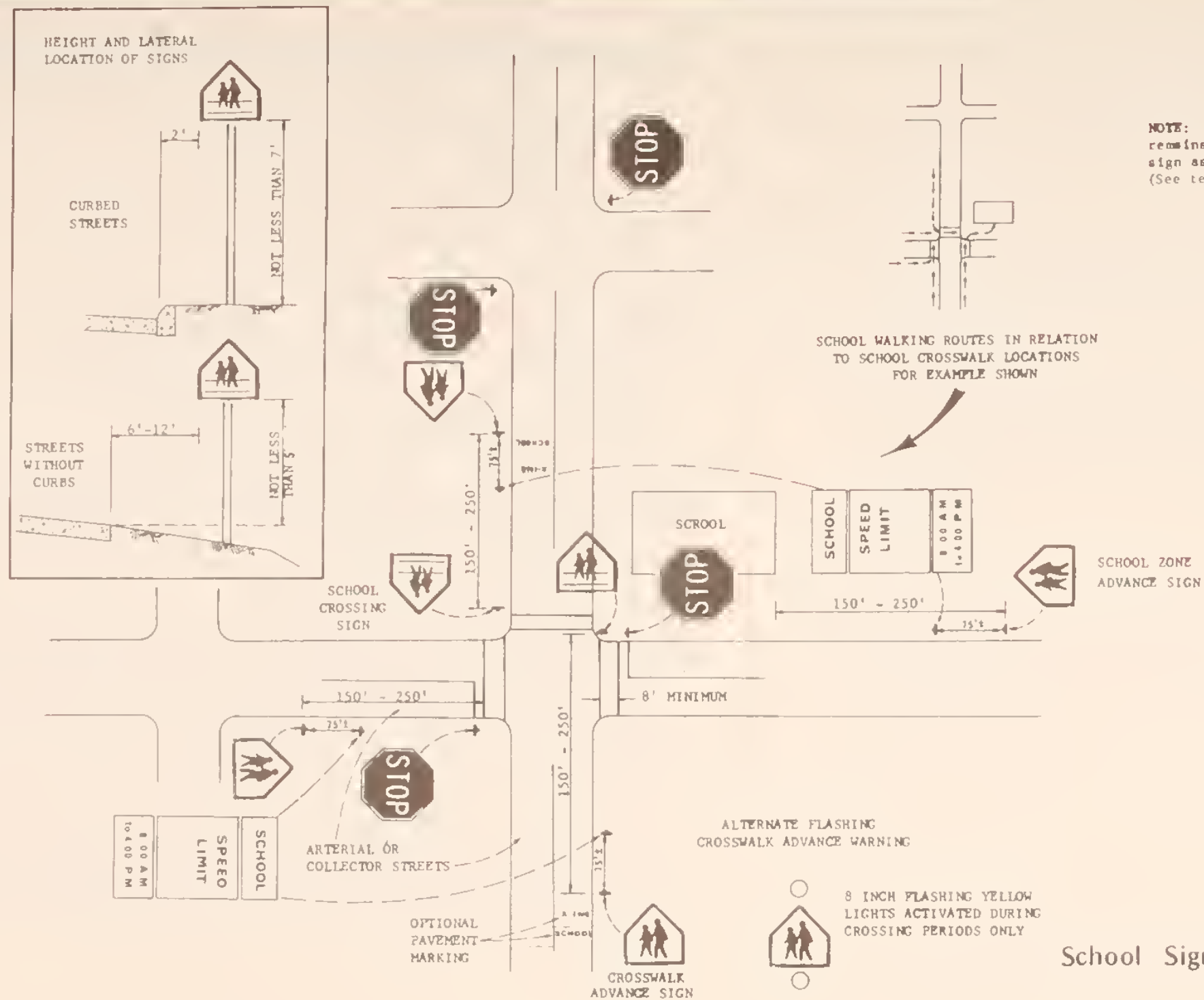
As contained in the Code of the City of Missoula, Section 20-64, when passing a school building or grounds continuous to a street, the speed limit shall be 15 MPH between the hours of 8:00 A.M. and 4:00 P.M. The speed limit sign assembly as shown in Figure 1 must be installed to conform to the above ordinance. However, speed and time restrictions as indicated shall not be construed as a recommendation of this policy guide. To the contrary, it is strongly urged that this statute be studied and higher speed limits and different time restrictions be established for school zones.

School crosswalks and school zone signing should normally be restricted to arterial and collector streets. Figure 1 also shows lateral placement and mounting height standards. Placement of advance signing should be carefully accommodated to highway design and alignment features, other signing, and roadside development. While school area signs ordinarily need not be reflectorized or illuminated, if there is considerable use of school buildings by children during hours of darkness, reflectorized signs and markings should be used in order to provide adequate nighttime visibility.

Where sight distance conditions so require, curb parking in advance of crosswalks should be prohibited beyond the minimum 20 foot distance on a through street or 30-foot distance on the stopped street as required in the State of Montana Vehicle Code. At unprotected mid-block school crossings, parking prohibitions identical to those shown for mid-block pedestrian signals should be used (See Figure 2).

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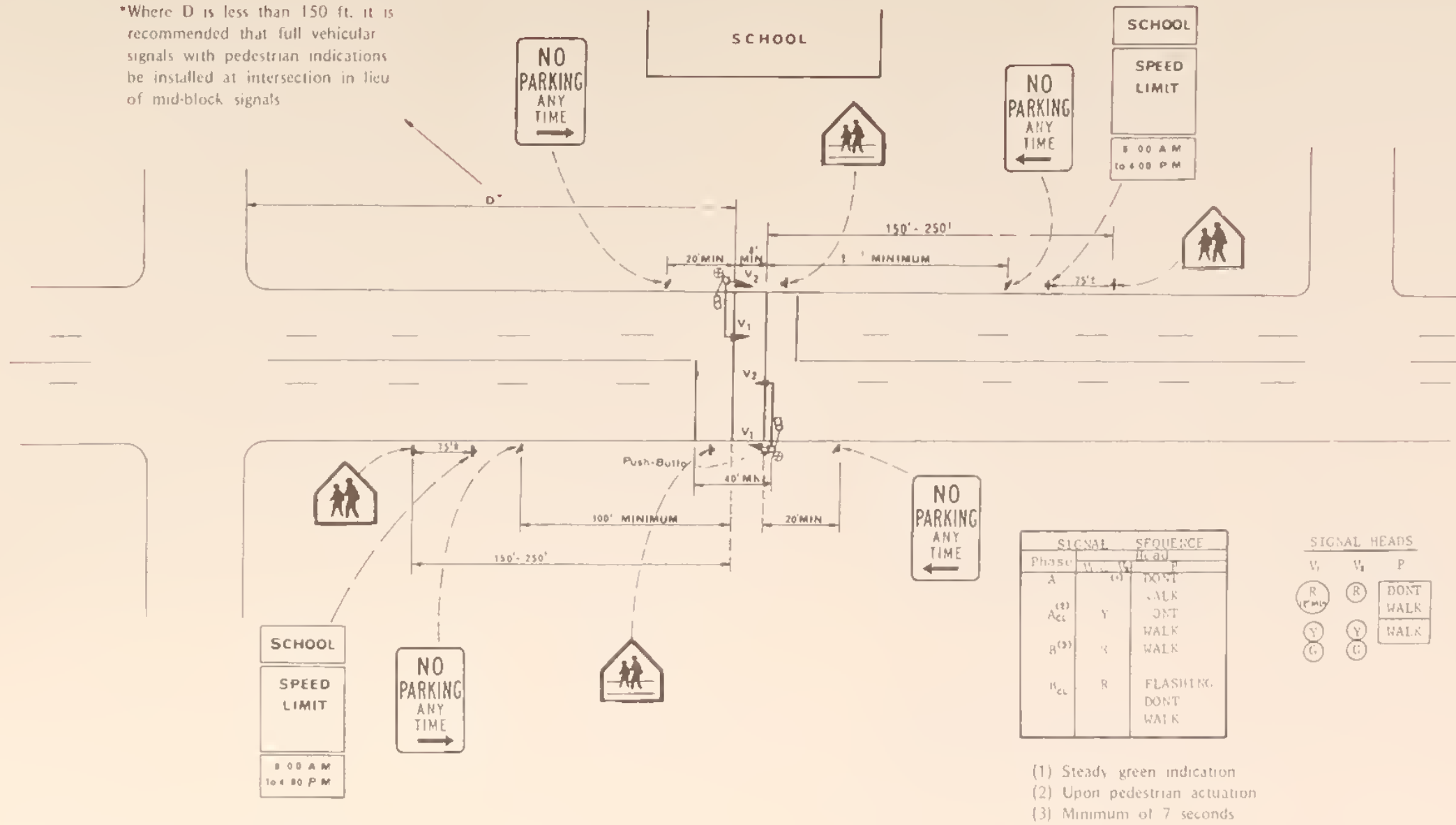
\* *Manual on Uniform Traffic Control Devices for Streets and Highways*, U.S. Department of Transportation, Federal Highway Administration, 1971, U.S. Government Printing Office, Washington, D.C.



School Signing & Marking Standards

FIGURE NO. 1

\*Where D is less than 150 ft. it is recommended that full vehicular signals with pedestrian indications be installed at intersection in lieu of mid-block signals



NOTE If the current ordinance remains in effect, the speed limit sign assembly is required as shown. (See text)

Mid-Block School Pedestrian Crossing & Signing Standards

FIGURE NO. 2



The crosswalk advance sign supplemented with flashing yellow lights should be considered for application at locations where:

The crossing is used by 40 or more school-age pedestrians during each of any two hours at an uncontrolled crossing (no traffic signals or stop signs present) located 600 feet or more from the nearest controlled crossing, and

The vehicular volume exceeds 200 vehicles per hour during the times that children are going to and from school for any purpose, and

Prevailing traffic speed exceeds 35 mph, or approach visibility is permanently restricted to less than the required safe stopping distance for the prevailing speed of traffic:

| <u>Approach Speed</u> | <u>Required Safe Stopping<br/>Sight Distance</u> |
|-----------------------|--------------------------------------------------|
| 30 mph                | 200 feet                                         |
| 40 mph                | 275 feet                                         |
| 50 mph                | 350 feet                                         |

A flashing yellow school advance sign shall operate only during normal times of arrival and departure of school children or during special school events, and such signal shall be controlled by a time clock.

SCHOOL AREA TRAFFIC SIGNALS

Contrary to common belief, signal control does not automatically increase overall traffic safety. Indiscriminate application must be avoided since unjustified, ill-advised signal controls lead to intentional violation, increased hazard, unnecessary delay and diversion of traffic to less desirable alternate routes.

A school signal may be warranted at an established school crossing where traffic engineering study indicates that there is inadequate number of gaps in the traffic stream during the period the children using the crossing (fewer gaps than the number of minutes in that same time period), no other controlled crossing is available within 600 feet, and other remedies such as adult crossing guards on alteration of school boundaries are not feasible. School pedestrian signal control standards are shown in Figure 2.

Figure 3 indicates guide values for combinations of traffic volume, street width, and school pedestrian crossing volumes at which school signals may be desirable. These are not

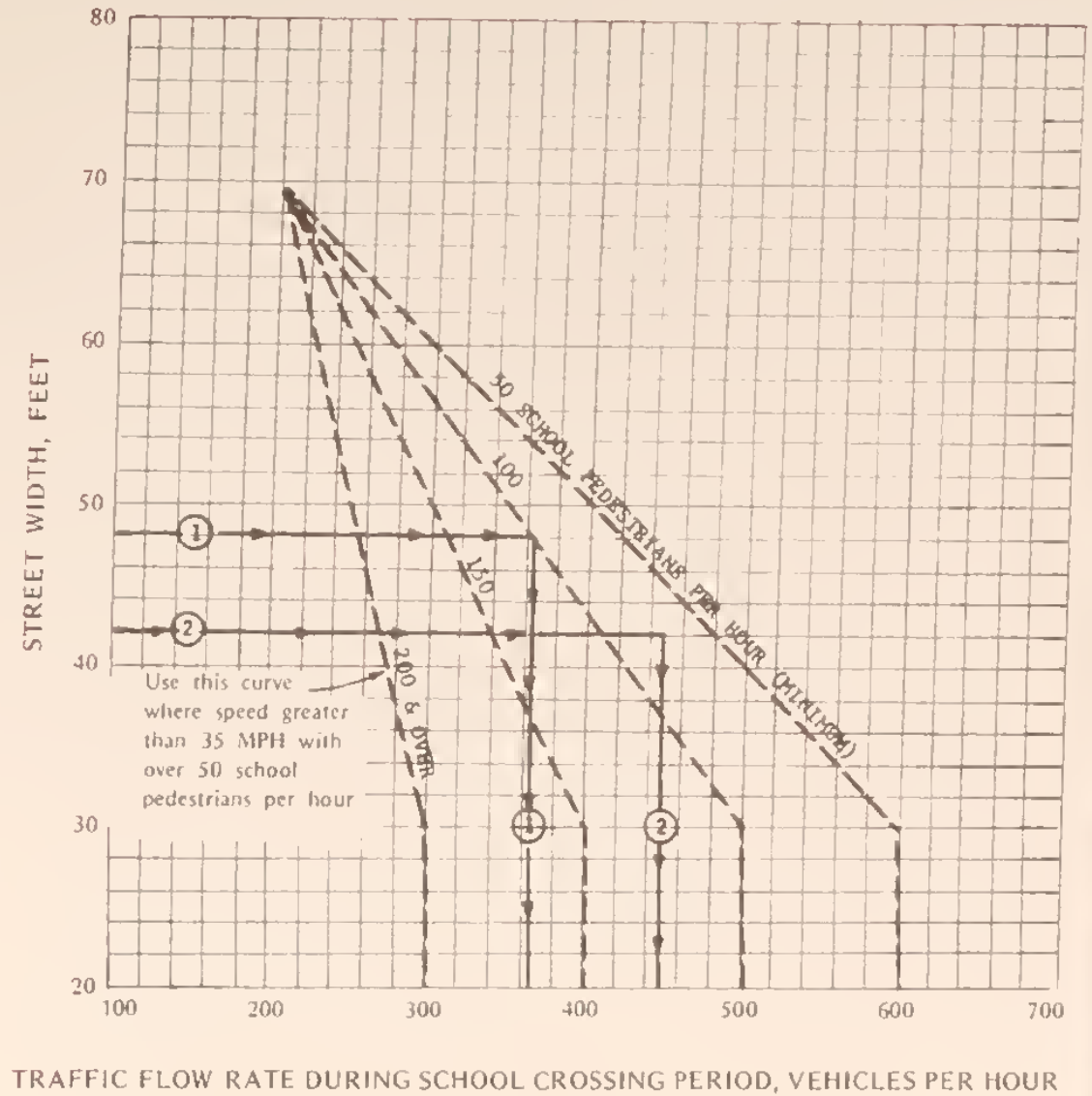
mandatory warrants in themselves, and those sites which meet the conditions set forth therein should be given careful detailed engineering study to verify whether signals are in fact needed. Final determination of this need should be based upon studies of crossing gap adequacy, site and traffic conditions, and accident history.

Where the desired location for mid-block school signals is within 150 feet of an adjacent uncontrolled intersection, it is preferable to provide signalization with both pedestrian and vehicular control at the latter in lieu of a mid-block signal.

School pedestrian signals should be set to flashing operation (vehicle signal heads display flashing yellow and pedestrian indications turned off) when the school is closed for extended periods of time such as during the summer, providing that it is ascertained that the school-age pedestrian crossing volume is negligible at that time. Signals shall not be turned off completely unless the vehicular signal heads are hooded.

Example 1 Given: 100 pedestrians/hr., street width 48 ft., current traffic 400 vehicles/hr. Chart shows minimum traffic volume required to warrant signals is 365 vehicles/hr. Therefore signals are tentatively warranted subject to confirmation from detailed engineering field study.

Example 2 Given: 75 pedestrians/hr., street width 42 ft., current traffic 400 vehicles/hr. Minimum traffic flow to warrant signals is 450 vehicles/hr. Therefore signals not warranted.



Traffic Signal Warrant for School Pedestrian Crossing

FIGURE NO. 3





